AMERICAN MACHINIST

February 5, 1941

International News Photo

Making the Weight—*The custom of weighing in before a fight is practiced in shell shops as well as in the prize ring*

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MAJOR ARTICLES

4,000 Motors a Day 43
Oil for Accuracy ..... *John Sasso* 46
Train Men for Your Job ..... *William Finkl* 49
Spun Shapes ..... *V. A. McChesney and R. J. Salisbury* 51

ARMAMENT SECTION

Tooling Set-Ups for H. E. Shell ..... *Ben C. Brosheer* 59

PRACTICAL LETTERS

Tools for Making Ring Clamps ..... *Charles H. Willey* 54
Level Aids in Drilling Straight Holes ..... *Fred Mueller* 54
Measurement of Coatings ..... *H. T. Coates* 55
Brazing Locomotive Driving Boxes ..... *John Deering* 55
Quick Clamping of Work ..... *Eugene Grosz* 56
A Holder for Grinding Tool Bits ..... *John W. Gerdel* 56

SHORT ARTICLES

Do Profit Limitations Save Our Money? 53

NEWS OF THE INDUSTRY

Gaging Business 84b
Watching Washington . 84i
Inside Detroit 84g
Names in the News 84k
Plant Expansion 84k
Obituaries 84l

DEPARTMENTS

Reference Book Sheet .. 81
Editorial 84a
Shop Equipment News .. 85
New Materials 95
Trade Publications 95
New Books 96

EXTRA · *The News* · EXTRA

Coming March 19

THE TOOL ENGINEERING NUMBER

of American Machinist

FEATURING

SHOW-IN-PRINT SECTION — Picturing and describing what's new at the Machine & Tool Progress Exhibition in Detroit, March 25-29.

LIST OF EXHIBITORS—And other data about this Show, giving you your personal Preview, Guide & Record.

DIE & PUNCH STEELS — Special 12-page Section, the 11th in the Working of Materials series, giving complete data in summarized, easy-to-use form.

MACHINING OF HIGH-EXPLOSIVE SHELL — Tooling standard equipment for shell production.— Armament Section No. 14.

FLOOR PLANS FOR MODEL TOOLROOMS — How to save steps, space and time in toolroom and toolcrib layout.

CUTTER GRINDING FOR MAXIMUM LIFE — An authoritative article offers definite suggestions for increasing production.

STEEL FOR SMALL TOOLS — A. H. d'Arcambal of Pratt & Whitney, President of the American Society of Tool Engineers, is contributing this special article.

HOW THE SMALL SHOP CAN TRAIN APPRENTICES — O. L. Harvey, a specialist on apprentice training of the Department of Labor, shows the way to solve a present vital problem.

CARBIDES FOR SMALL-LOT MACHINING — W. J. Burger, director of engineering for Warner & Swasey, shows how carbides can be used effectively on limited quantities.

AND REGULAR DEPARTMENTS, NEWS, SPECIALIZED FEATURES

WHAT'S IN THIS ISSUE

NOTHING NEW?

Like the classic controversy over the chicken and the egg, the argument about the truth of there being nothing new under the sun will probably never be settled. But as evidence to help prove there *is* something new, we'd like to present this issue's Armament Section, page 57. For it's the starter of a series of articles on shell manufacture, the like of which you've never seen published before.

With our usual pardonable pride we'd like to remind you that this series is probably the most ambitious editorial undertaking on the actual production of munitions which has ever been attempted in this country. For the first time the Army has let down the bars on a vast amount of information which has hitherto been considered absolutely confidential. Months and months of tedious research work went into the articles' preparation before even the first typewriter key was struck. Hours of eye-strain were devoted to poring over acres of blueprints and reams of specifications. Authorities by the dozen were consulted. Experiences of shop foremen, works managers and production engineers were taken into account. And from the mass of material, along about Christmas, began to emerge The Shell Series.

The result? Information, a vast amount of information, which we sincerely believe will be of tremendous assistance in helping any plant, large or small, in the manufacture of shell. There are lots of different kinds of shell, and lots of ways of making them. One of the outstanding virtues of our shell series is that it will describe in detail various ways of doing the same job, so that whatever equipment is at hand can be turned to the task at utmost efficiency. For while new equipment is better than old, old is better than none at all. With the present tool shortage, too little emphasis is placed on getting out the job with present machinery. It's our conviction that the shell series will help in focusing attention on this point.

Such a staggering editorial job is usually done best by the efforts of one man. To associate editor Ben C. Brosheer goes credit for amassing more information on shell making than possibly anyone outside the armed forces has ever seen. Since last Fall he's done little else. As the series will continue well into the Spring, he's not out of the woods even yet. But the work is in process, and "deliveries" are being made on schedule. So you can count on more and more facts, figures and diagrams for many issues to come.

PARADISE

Imagine a shop where the quantity produced runs up in the millions, where design changes are few and far between, where only a handful of models are made. A veritable paradise, you might say. Well, maybe. Certainly such a set-up makes possible true mass production, with attendant opportunities for spectacular savings through tricky devices. A shop closely approaching this ideal is the small appliance motor plant of Sunlight Electrical Division of General Motors, where 4,000 fractional-horsepower motors a day are turned out by fewer than eight hundred shop workers. On page 43 are described a few of the tricks Sunlight uses.

AGAIN: ALUMINUM

After a brief pause for our Annual Buyers Reference Number, the series on the cold working of sheet aluminum resumes on page 51 of this issue. This particular installment, compiled by V. A. McChesney and R. J. Salisbury of the Aluminum Company of America, deals in detail with spinning. Specific suggestions and accepted practices characterize the greater part of the information.

V. A. McCHESNEY and R. J. SALISBURY
. . . specific pointers on spinning

STREAMLINED TRAINING

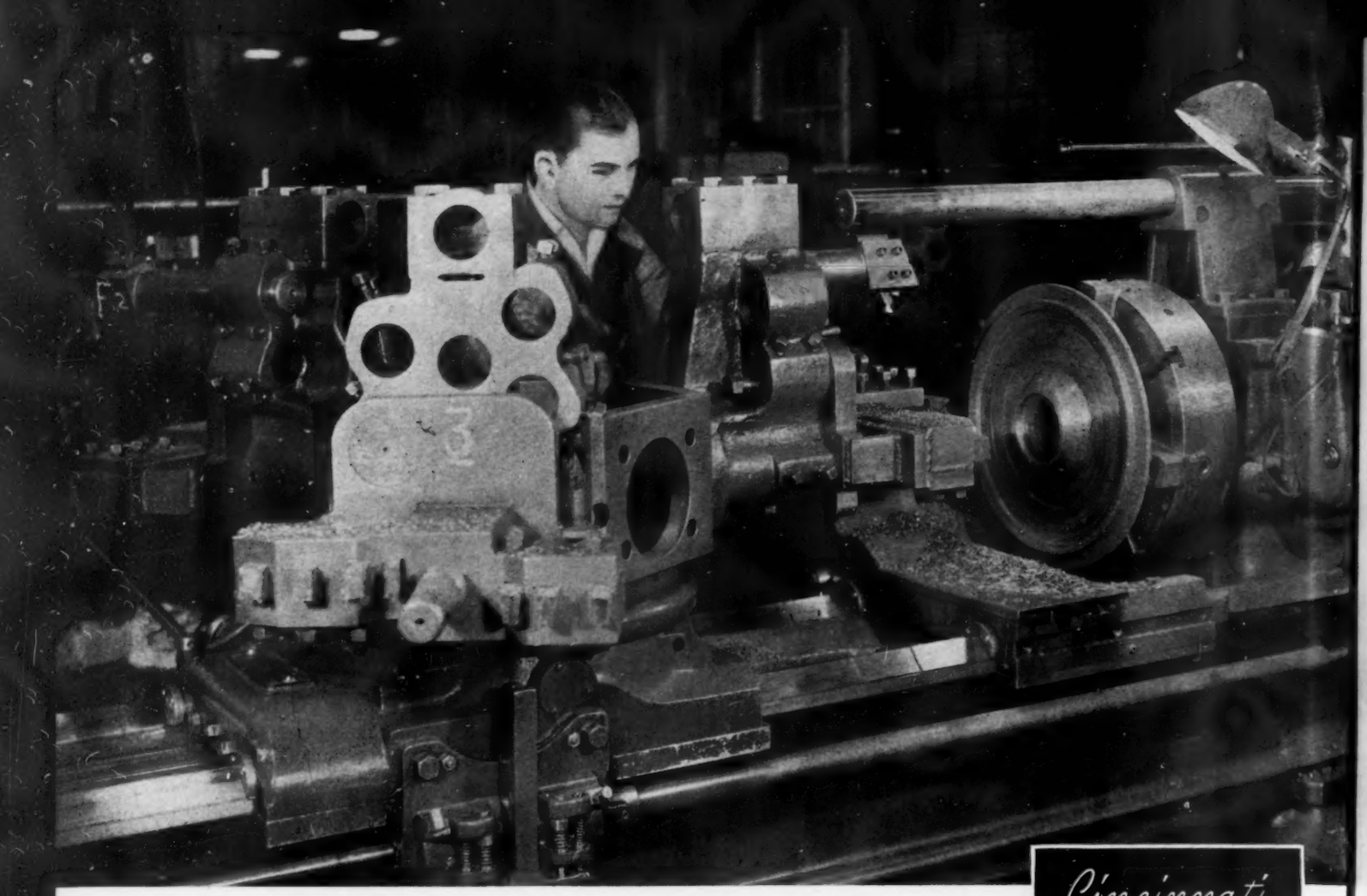
It's axiomatic that with new problems come new solutions. That seems to be true of the present skilled labor shortage, for many and varied have been the suggestions for lightning training of machinists for the pressing production job ahead. One of the most analytical of these programs is one put forth by the National Metal Trades Association, which has made a comprehensive study of the problem and worked out a practical solution. On page 49 William Finkl, of A. Finkl & Sons Company, outlines actual, tangible steps to help streamline your training. We feel they'll go a long way toward helping *any* training program.

WELL OILED

You've met John Sasso before. You may remember that he was the author of a couple of articles on infra-red baking, which we ran a few months ago. Those articles, incidentally, have met with such acceptance that several thousand reprints have been requested, and they've been translated into Spanish for distribution in South America —to counteract insidious Nazi propaganda, according to John. Be that as it may, he's crashed through again with the same type of data-jammed article, which appears on page 46. It's on machine tool lubrication, a subject which required considerable research and a lot of cross checking. The story has met with the enthusiastic approval of half a dozen lubricant makers, so we know you'll find it both accurate and authoritative.

COMING

Time was when abrasive cutting off was considered a pretty crude process. But like many others it has emerged into the realm of respectability, thanks largely to rubber and plastic bonded wheels and better machines to use them. Scheduled for an early issue is an article on the various applications of abrasive cut-off machines, complete with data on wheel types, sizes, grits and speeds. Also up for discussion is the problem of bar stock vs. tubing for certain screw machine parts. And, on the lighter side, some cartoons which dramatize pointers on preventing sabotage. Yon won't want to miss the next AMERICAN MACHINIST!



Cincinnati ACME UNIVERSAL TURRET LATHES

SPICER MFG. CO. takes advantage of CINCINNATI ACME power and rigidity to finish "Hydraulic Case Covers"

The size of work being handled on this No. 3S CINCINNATI ACME "Universal Fixed Center" Hollow Hexagon Turret Lathe in the Toledo plant of the Spicer Manf. Co. calls for a machine which must be depended on for power and rigidity.

Note the large piece in the chuck—a tank transmission part of cast iron approximately 18" in diameter. Three special piloted cutter blocks are employed for turning, forming and sweep facing one side of this "Hydraulic Case Cover." The finish is smooth and free of chatter with the part machined to close limits.

Such work as this can invariably be handled economically and efficiently on CINCINNATI ACMES because these machines are designed, built and powered to machine large diameter parts with utmost speed and accuracy.

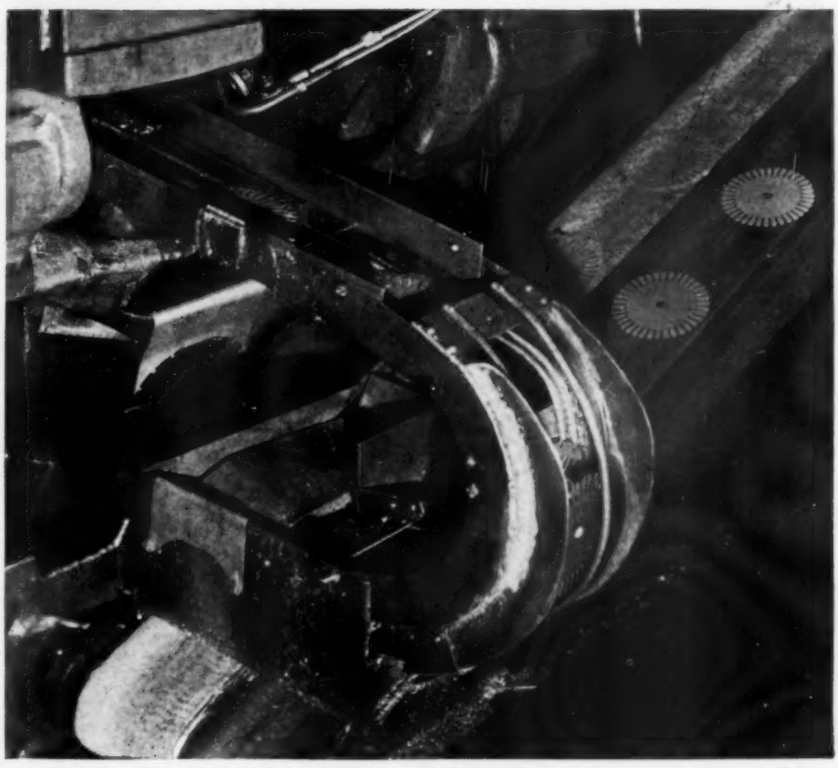
Write for Engineering recommendations on any problem involving Turret Lathe production. Ask us for assistance in meeting your difficult problems.

...The ACME MACHINE TOOL CO., ...CINCINNATI, OHIO.

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

4,000 Motors a Day

Manufacturing only a few sizes and types permits genuine mass production economies in making home appliance electric motors



A stator lamination with center scrap (rotor blank) nested inside it falls down the press chute incline; then it hits a reverse curve where the two parts are separated for delivery to a two-belt conveyor

MANUFACTURE OF A PRODUCT in few sizes and variations affords an opportunity to develop production processes to a high level of efficiency. For this reason, Sunlight Electrical Division of General Motors Corporation is able to turn out 4,000 fractional-horsepower motors daily in a plant measuring 240x520 ft. and employing only 780 shop workers, mostly women. The plant operates on a two-shift basis, producing $\frac{1}{6}$-, $\frac{1}{4}$- and $\frac{1}{3}$-hp. motors for household-appliance manufacturers.

In the punch press department, which produces rotor and stator laminations, silicon-steel strip is unloaded at the rear dock in flat bundles. This stock is immediately slit to correct width and trucked to racks at seven Minster inclined hand-fed presses. Stator laminations are produced in compound "no-scrap" dies. No scrap skeleton is allowed; only a square equivalent to the over-all size of the stator is cut from the strip.

At each up stroke of the press, a completed stator lamination with nested center scrap is kicked onto a delivery chute. This center piece is subsequently made into a rotor lamination. The only waste consists of slugs pierced from the stator lamination for rivet holes and locating holes around the periphery, the rotor shaft hole pierced in the center, and corners trimmed from the stator lamination.

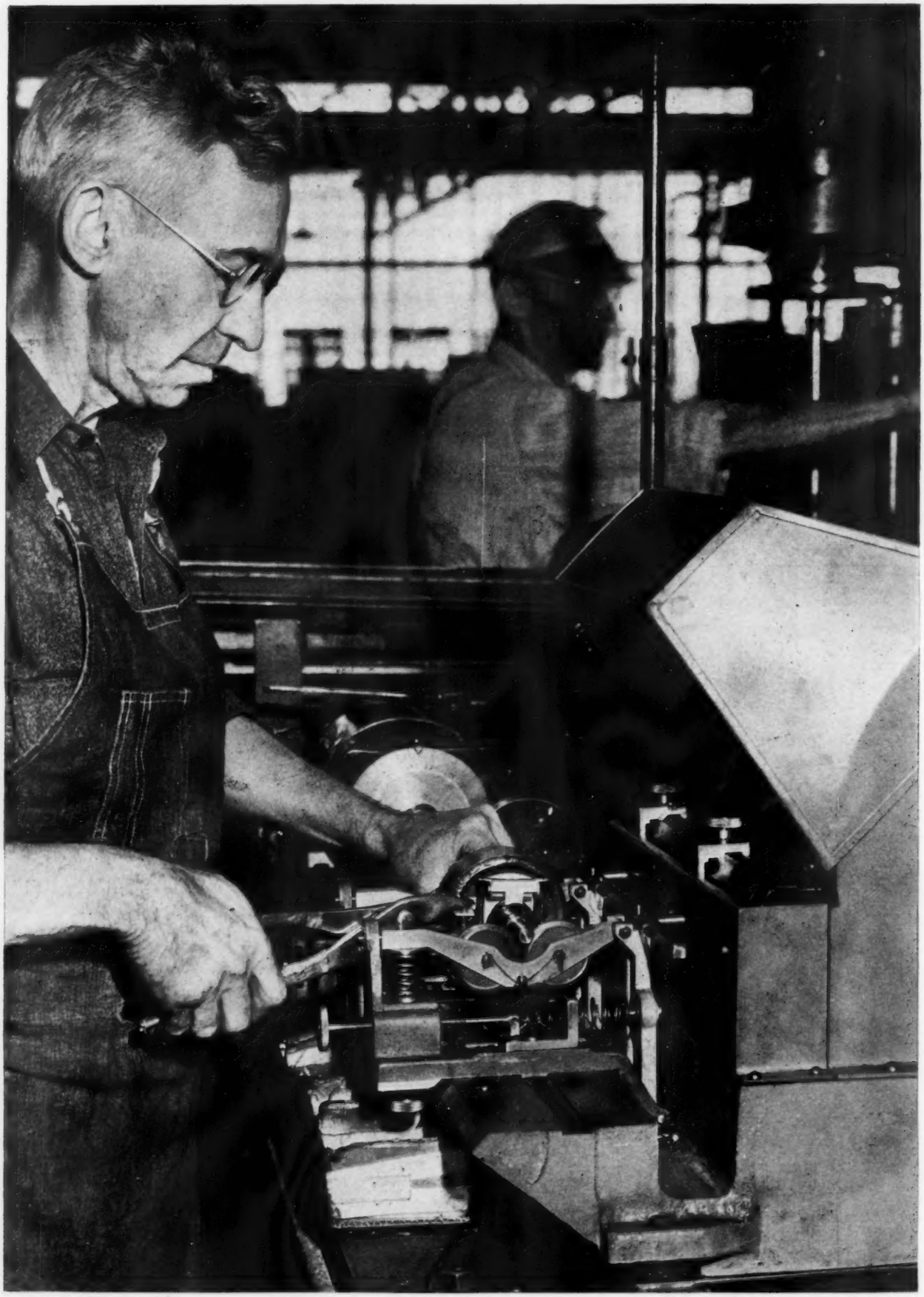
Use of compound dies for this first press operation has several advantages: (1) rotor laminations are made exactly in proper relationship to the stator laminations, (2) rivet holes in stator laminations are so accurate that the rivets act as dowels, and (3) later machining operations are simplified.

The delivery chute takes away the nested stator and rotor laminations without handling, and separates them automatically onto two conveyors which stack them ready for further operations. The chute never fails to perform its function. The nested pieces ride together down inclined rails. As they start to drop through a reverse curve, the larger stator lamination is jerked into a sharp curve by guide flanges, while centrifugal force throws the smaller part against an outer concentric loop. The stator lamination moves along a higher level and is carried over to the inside belt of the two-belt elevator. The center piece, moving along a lower level, hits a gate and drops onto the outer belt.

Stator laminations are stacked on conveyor hooks at the belt discharge and are hung upon a storage conveyor. Center stampings are stacked in tubes and loaded into other presses for production of rotor laminations. Compound dies pierce three ventilating holes and a series of closely spaced conductor-bar holes around the periphery and trim slugs left from the stator conductor holes. Finished rotor laminations are stacked and hung upon a storage conveyor.

Stator laminations are removed from the storage conveyor and weighed to select the correct number per stator core. They are aligned on a mandrel about which sweeps an arm that catches a half hole notched in the periphery. In this way, laminations are stacked in correct relationship. Two loose rivets hold the stack securely.

After stress relieving (6 hr. at 1,550



In balancing the rotor, a lead weight is riveted into a hole at the proper angular position in switch or fan

F.) to overcome punching strains, the loose assembly is placed on an expanding mandrel and riveted. This operation is done on a double-ram HPM hydraulic press which applies 40 tons to the laminations and 75 tons to head the rivets. The bore will not be out more than 0.002 in. at any point because compound dies were used in the first place and the expanding mandrel was used for the riveting and compressing operation. The internal surface is smooth, thereby saving a machining operation.

Correct relationship between bore and outside diameter is also obtained by using expanding mandrels when machining tenons on the outside edges of the assembled stator. This operation is performed on a four-spindle automatic. Housings are a snap fit on the tenons.

Rotor laminations are removed from the storage conveyor, weighed and shaken into alignment on oscillating mandrels. Conductor bars are inserted by a special General Motors Research machine. It consists of a straightener taking copper wire from a reel, a flying shear for cutting to length and an indexing and inserting mechanism for pushing the bars through the closely spaced holes around the rotor lamination periphery. This machine is automatic in operation, except for hand insertion of a stack of aligned laminations. An adjacent HPM press completes the assembly, which is passed into a preheating oven prior to welding the conductor bar ends into a continuous bead around the ends of the rotor.

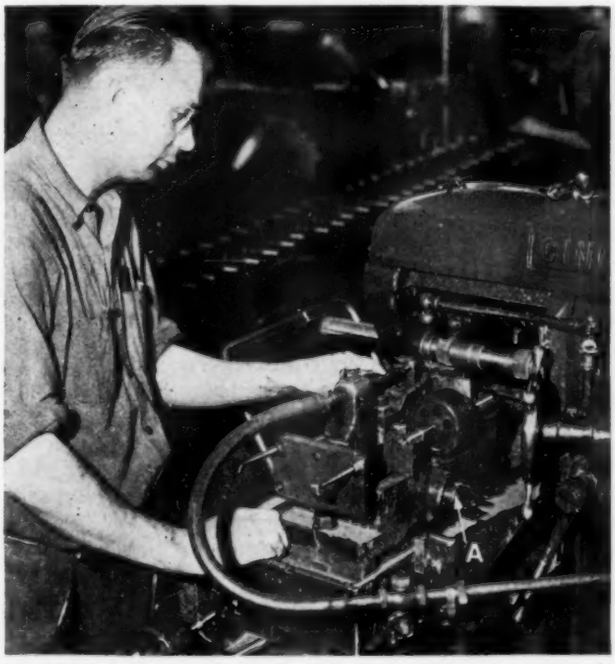
Shafts are produced in an adjacent automatic set-up. They are pressed into the cooled rotor, and bearing surfaces are centerless ground. Flats on each end of the shaft are milled on a Cincinnati with a fixture carrying two rotor-shaft assemblies in V-blocks. As the table traverses to the cut, a cam on the table contacts a stationary cam bar, locking the fixture. After the flat on one end of each shaft is milled, the rotors are reversed for milling the other flats.

Spindles Run Backwards

The rotor outside diameter is turned, not ground. Sunlight has found that grinding smooths over the spaces between laminations, which is held to be undesirable electrically. Turning produces a smooth, accurate surface with the laminations more or less distinct. The set-up for precision turning the rotors consists of two special three-spindle Ex-Cell-O machines. The spindles run backwards and the cut is down to carry away chips. Special shape for roughing and finishing Carboloy tools is a half moon which is very nearly flat without a sharp edge to be nicked or grooved. Tools are almost flat at the back, to attain smoothness of the machined surface without destroying identity of the laminations. Contrary to general practice, the tools cut below center, as this condition makes possible machining of the lamination material. There is no digging in or tool breakage.

After the switch and the fan are assembled to the rotor assembly, the part is balanced on a special General Motors Research machine. This machine shows the out-of-balance condition for each end of the shaft at the journals. The part is held by slipping one end of the shaft into a special chuck having a ball detent engaging the flat on the shaft. The chuck is connected to the driving spindle through a universal joint, so that the rotor can be inserted and removed quickly. Vibration in the work carrier is picked up electrically and thrown on a screen, which shows two streaks of light corresponding to the unbalance at both ends of the shaft. Both streaks must run between tolerance lines. Angle of unbalance is shown where the two streaks converge. A scale indicates amount of unbalance.

After the balancing machine is stopped, the driving spindle is turned by hand to the angle of unbalance read on the scale. A lead weight corresponding to the amount of unbalance is then slipped into a hole in the periphery of the switch or ventilating fan and is squeezed tight with pliers. After an electrical test, the rotor is placed on a conveyor for transfer to the assembly department.



To mill flats on rotor shafts, two assemblies are laid in a fixture automatically clamped by table movement. Actuating roller A on the fixture is controlled by a fixed cam bar

Down-cutting roughing and finishing tungsten-carbide tools precision turn the rotor outside diameters. Grinding is omitted as it impairs electrical properties of the laminations

Oil for Accuracy

BY JOHN SASSO

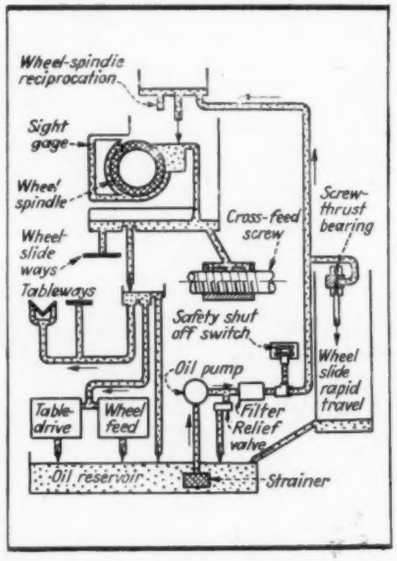
The right oil in the right spot will prolong machine tool life and preserve precision. Some frequently found lubrication systems are described below

SELECTION of a proper lubricant for machine tools depends upon the duty involved and the methods by which lubricant is applied. An oil must meet definite requirements of viscosity, ability to flow at low temperature and resistance to breakdown in service. Viscosity must be sufficient to prevent metal to metal contact, but must not be so high as to cause high internal friction or failure of the oil to penetrate close clearances. Breakdown resistance must be sufficient to prevent decomposition or gumming under continuous service; the oil must also be free of impurities which might injure machine parts.

Methods of applying lubricants include cascade, splash, force-feed oil or grease, hand-pressure grease, sight-feed oil cups, sight-feed multiple oilers or various combinations of these systems. In the cascade method, the oil is raised by pump to a level above the points being oiled and returned by gravity to the sump after being led to the parts requiring lubrication. A screen to remove coarse particles, or a filter in the pump line should be used. However, there is no indication as to whether the oil is being supplied to the proper points. In splash systems, wherein lubricant is picked up and splashed on moving parts, means for removing dirt or other foreign matter from the oil are seldom provided. Force-feed systems usually employ a mechanically operated pump with multiple outlets and tubing which carries the oil to parts being lubricated; the tubing is brass or copper. These latter systems also include a filter rather than the usual screen.

In splash lubrication, the crank case or oil sump is completely inclosed and the entire system is oil tight. The viscosity of the oil should be as low as is consistent with requirements; this will insure rapid sediment precipitation. Since the oil may be used over and over again without purification or external cooling, the capacity of the reservoir is usually made sufficiently large so that oil operating temperatures stay within a reasonable range. Machine manufacturers' recommendations should be carefully followed to insure proper lubrication with such systems. With ring or chain oilers, the same conditions hold for lubricant selection.

With cascade lubrication an excess of oil is supplied to the moving parts, and the oil not only acts as a lubricant, but also tends to act as a cooling medium to carry off frictional heat. It also keeps the bearing surfaces relatively free from dust and dirt. Some installations furnish a central sump from which the oil can be removed for cleaning or filtering.



Oil is pumped under pressure to the crossfeed screw thrust bearing of a Brown & Sharpe grinder. It is fed by gravity to wheel slide, wheel spindle, crossfeed screws, ways, drive and feed mechanisms

In pressure circulation, oil is forced to the bearings at pressures ranging from 5 to 15 lb. per sq. in. Lubricant requirements are controlled to a large extent by operating and constructional conditions. If ample purifying and circulating capacity is provided in the circuit, the bearings will be continually washed out, and dirt and water will be precipitated. The oil selected should resist emulsification, as this would tend to clog the system.

Lubrication of lathe gears improves running characteristics and life by preventing metallic contact between teeth. Gear lubricants should be heavy enough to withstand considerable tooth pressure, and adhesive enough to resist centrifugal force. A straight mineral gear lubricant having a viscosity ranging around 100 Saybolt Universal Viscosity at 210 F. is usually recommended, although speed, temperature and tooth pressures must be taken into account before final recommendations are made. Either cascade or splash feed lubrication is usually used in lathe gear sets. Where gears are small, accurately cut and aligned, they can be lubricated effectively by a relatively fluid lubricant of sufficient viscosity to prevent metallic contact. In cases where the gears dip into the oil, too viscous an oil may add to the power loss on account of added friction.

One Oil for Gears and Bearings

Where lathe bearings are part of an inclosed gear case, lubrication is obtained through the gear lubricant in the case. Since spindle bearings are closs-fitting to give an accurate and true running spindle, allowable clearance for lubricant is small. Therefore the lubricant must be heavy enough to be suitable for the gearing and to resist squeezing out by pressure, yet light enough to allow penetration of the small bearing clearances. The best lubricant will be a mineral oil of 150 to 100 S.U.V. at 100 F.

Lathe ways should be wiped daily with an oil-soaked rag so that oil is distributed over them. Felt wipers attached to sliding members tend to keep the ways oiled. The felt wiper should be cleaned once a month and renewed when necessary. Wiping oil should have a S.U.V. of 300–100 at 100 F., approximately. Some manufacturers recommend heavier oils for heavy duty equipment.

When the apron and cross-slide are lubricated by individual oil holes or oilers, daily refilling is sufficient. Automatic methods include pump-drive by apron handwheel or a reservoir on the top of the apron which supplies oil through tubes to the various roller

bearings in the apron. The apron gears dip in the oil in the reservoir to carry oil throughout the gear train. A built-in plunger pump may distribute oil to a central oil reservoir. These systems require attention at regular periods, depending on their capacity.

In change-gear mechanisms for the feed, longitudinal shaft and screw bearings and back-gear shaft bearings have larger clearances for the lubricant than spindle bearings. Oil is usually applied either by a one-shot oiling system, centralized oilers or individual grease cups or fittings. A mineral oil of 200–300 S.U.V. at 100 F. is satisfactory, the heavier oil being used in the larger lathes.

Greases on Drilling Machines

Parts to be lubricated in the drilling machine include bearings, ways, traversing screws and nuts, and gears, the most important being the spindle bearings since these carry end thrust in addition to radial loads. Service conditions vary, but a suitable lubricating film must be maintained between the surfaces of the bearing parts. On sensitive drills, upright drills and radials, a light grease injected periodically is sometimes used. Too heavy a grease will cause bearings to heat. The grease must be free of non-lubricating fillers. When applying the grease with a gun, the end of the gun and the opening into the bearing must be clean. Head construction sometimes permits lubrication of the spindle bearings with the same system that lubricates other moving parts. Oil viscosity will depend upon speed: the higher the speed the lighter the oil. It should have 150–300 S.U.V. at 100 F.

Shaft bearings in the power transmission units are generally mounted in an oil-tight case and are lubricated by the gear lubricant. Bearings supporting belt-driven shafts and back-gear shafts are usually lubricated through individual oilers or grease cups; oil should be 200–300 S.U.V. at 100 F.

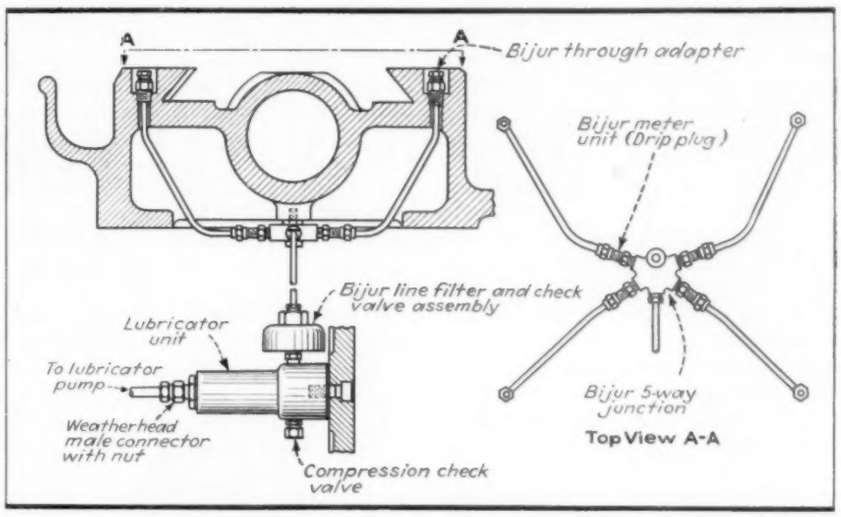
Gears in drilling machines running in an oil-tight case, should be lubricated by a mineral oil having viscosity of approximately 200 S.U.V. at 100 F. For back gears, dipping into the lubricant, oil used should be adhesive enough to cling to the teeth and not be thrown off by centrifugal force, and should have a viscosity of approximately 250 S.U.V. at 210 F. Open gears must be thoroughly cleaned every six months. Speed and feed change gears running in oil, require a relatively fluid lubricant; too viscous an oil will cause undue heat and friction. An oil having viscosity of approximately 300 S.U.V. at 100 F. will generally meet requirements. Arm guide ways on a radial drill should be wiped at least daily with a rag and then oiled. Column surfaces on radial and the head and table guide ways on sensitive and upright drills should be kept damp with oil. Wiping with an oil rag once a week will suffice, using a mineral oil of approximately 300 S.U.V. at 100 F. Screws and nuts which adjust the table, or raise and lower the arm on the column should be thoroughly cleaned with gasoline every six months. When lubricated by hand a fairly heavy lubricant of approximately 100 S.U.V. at 210 F. should be applied periodically over the threads.

Satisfactory lubrication of a planer requires a plentiful supply of an oil light enough to penetrate into the small clearances and to furnish a suitable lubricating film. The oil must be heavy enough, however, to resist being squeezed out. Oil viscosity of approximately 280–300 S.U.V. at 100 F. is recommended. Some form of automatic lubrication is generally provided. In one, oil is delivered from rollers of a form matching the ways, supported in pockets filled with oil above the center of the roller. As the table travels back and forth the rollers contact the ways depositing oil. These pockets collect dust and dirt and should be washed out periodically with gasoline.

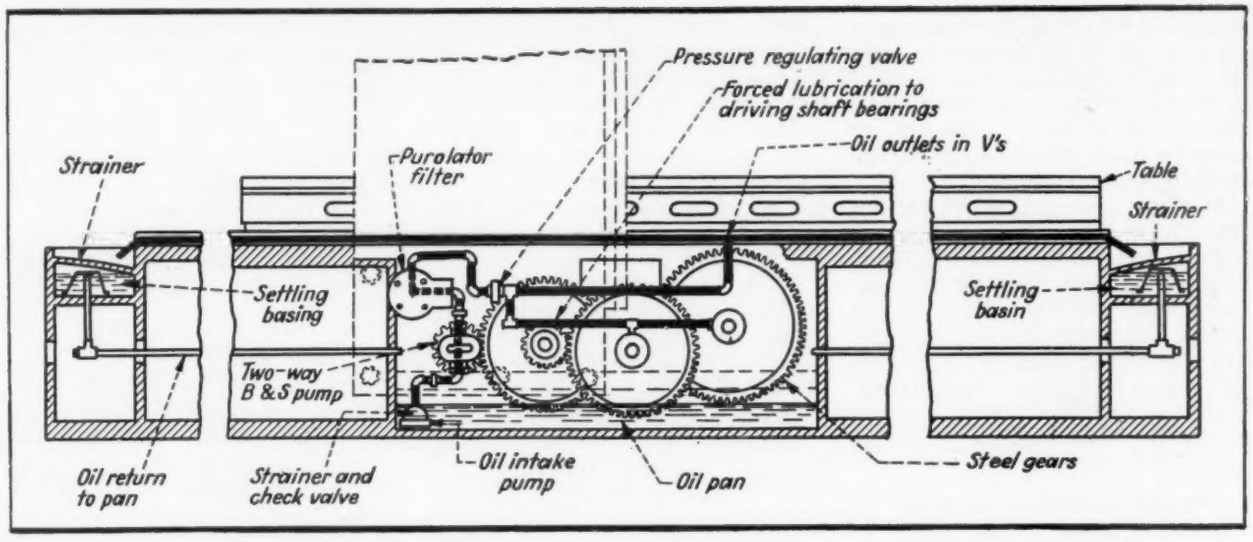
Planer gears and bearings for table movement are large, travel at slow speeds and carry heavy tooth loads. A fairly heavy lubricant that will adhere to the gear teeth should be applied periodically; it should have a viscosity of approximately 150 S.U.V. at 210 F. A mineral oil of approximately 300 S.U.V. at 100 F. should be used for bearings. Screws and nuts for tool slide feeding head movement along the rail, and for raising and lowering the rail on the housings, subjected to intermittent service, are exposed to dust and dirt, and should be cleaned every six months. With a central oiling system, no further attention is necessary. Ways should be wiped with an oil rag about once a week with an oil of a viscosity of approximately 220 S.U.V. at 100 F.

Systems Used on Shapers

Shaper ways, if not properly lubricated, may show uneven wear in an appreciable amount. On most machines, ram-ways are taken care of by the automatic system employed for lubricating other parts of the machine. On others, individual oilers are used. Mineral oil of approximately 300 S.U.V. at 100 F. is required. Ways require lubrication at least twice daily. When felt wipers are used, the felt should be cleaned yearly. Gears and bearings in the power transmission of a shaper are generally oiled by a central lubricating system in which a gear pump forces filtered oil to ram parts and bearings. Best results will be obtained with a fairly heavy oil with a viscosity of approximately 300 S.U.V. at 100 F. With gears and bearings of the speed transmission unit inclosed in an oil-tight case, an oil of about the same viscosity should be used. Column ways, crossrail ways, sliding surface on table support, and tool slide on the head should be wiped with an oil rag once a week, and oil not lighter than approximately 300 S.U.V. at 100 F. applied over the surfaces daily. Feed screws for tool slides are exposed to



Metered lubrication is furnished to the table of this Sundstrand milling machine by a junction which distributes the oil to four metering units



In the bottom of the table V of a Gray planer, oil fills a channel which extends almost to the ends of the table. Oil grooves cut in the V's distribute the film over the bearing surfaces

dust and dirt. A heavy lubricant having a viscosity of approximately 150 S.U.V. at 210 F. should be applied periodically over the thread surface, and screws should be cleaned every six months with gasoline.

Spindle bearings in a milling machine run at low speeds, but radial and thrust loads are appreciable. Any end play may cause chattering of the cutter. Bearings, adjusted for close fit, require proper lubrication. When these bearings have individual oil holes or sight feed oilers, light mineral oil of approximately 200–100 S.U.V. at 100 F. is required. Anti-friction bearings are lubricated by the gear lubricant in the driving unit. In some vertical machines, the high speed of the spindle or the design of the mounting makes such an arrangement impractical. In these cases, bearings are lubricated by a sight feed oiler adjusted to supply two or three drops an hour of oil with a viscosity of approximately 125 S.U.V. at 100 F. Heavier oil or too much oil will cause heating of bearings. With individual grease cups, a short-fiber soda soap grease should be used in limited amounts for ball bearings, and pressure gun grease for plain bearings. Bearings supporting shafts in the feed box are usually lubricated along with the gears by a flood or splash, or they may be taken care of by centralized oilers from which oil is carried through tubes. A mineral oil with a viscosity of approximately 200 S.U.V. at 100 F. should be used.

Ways should be wiped with an oil rag about once a week. Sliding surfaces of the overarm should be kept damp with oil. In hand oiling these surfaces, use a mineral oil of approximately 300 S.U.V. at 100 F. Traversing screws and nuts which raise and lower the knee on some machines, are continuously lubricated automatically, using the same oil as that for lubricating the power feed unit. In such cases attention is not required. On other machines the screw is grease packed, and it must be replenished periodically. Open screws should be cleaned every six months using a brush and gasoline, and at regular intervals a heavy lubricant of approximately 150 S.U.V. at 210 F. should be applied over the thread surface. For other screws not lubricated automatically, a weekly application of a mineral oil of 300 S.U.V. at 100 F. to the threads should be made.

In one make of wheel spindle on an internal grinder, after the oil has lubri-

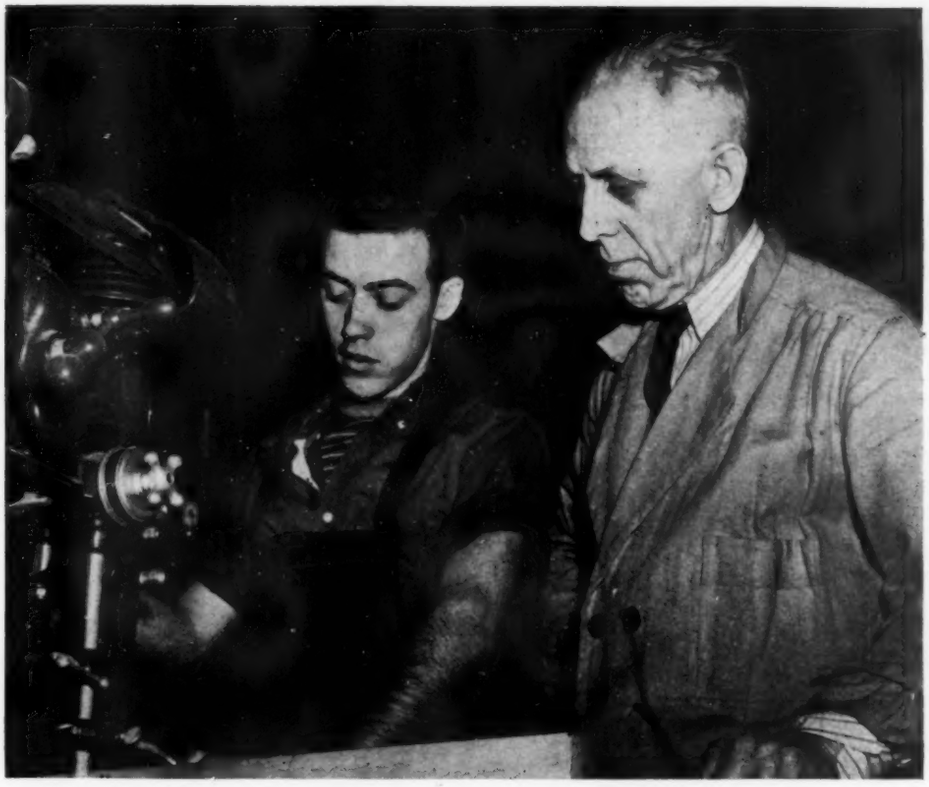
cated the bearings, it drips out at the ends. This type requires particular care in adding oil so that no dirt or foreign matter enters the oil chamber. Only a thin, mineral oil should be used; it should have a viscosity of approximately 105 S.U.V. at 100 F. Heavy oil will cause heating.

Spindle bearings of the larger surface grinders are so large that the surface speed will be high and the bearings will have to be constantly lubricated. On some machines with plain bearings, an oil ring carries the oil from the reservoir to the spindle, and grooves distribute it. These reservoirs should be drained and flushed out with gasoline or naphtha about every three months. The proper oil will be a mineral oil with a viscosity of approximately 105–150 S.U.V. at 100 F.

Bearings which support the magnetic chuck on the rotary surface grinders, work spindle bearings, and those in the various speed and feed change gear boxes, are oiled by individual oilers, or by grease cups, or by splash when they are part of an inclosed gear case. For individually oiled bearings, apply a mineral oil of a viscosity of approximately 200 S.U.V. at 100 F.; for those lubricated by grease cup or grease fittings a good grade of cup grease is required.

Speed and feed gears in grinders are usually taken care of either by central oilers, or run in a bath of oil in the gear box. Oil should have a viscosity of approximately 200 S.U.V. at 100 F. Gear cases should be drained, flushed out with gasoline or naphtha at least twice a year. For worm and worm-gear drives, best results will be obtained with an extra heavy oil with a viscosity of approximately 150–200 S.U.V. at 210 F. A mineral oil of approximately 200–300 S.U.V. at 100 F. will be satisfactory for the ways. On machines using a hydraulic system to reciprocate the units, oil is usually supplied under system pressure to the ways.

Due credit is hereby acknowledged to the following companies for furnishing source information and practical suggestions on the article content: The Pure Oil Company; Standard Oil Company of Indiana; Sun Oil Company; Gulf Oil Corporation; The Texas Company.



Many concerns are training their own employees for defense work

Train Men for Your Job

BY WILLIAM FINKL, A. FINKL & SONS COMPANY

Although a skilled labor shortage is still a reality, sound training programs are being developed. One of the most analytical of these has been offered by the National Metal Trades Association

IN SPITE OF the large volume of unemployment, the metal trades industry reports a serious shortage of qualified skilled labor, especially all round machinists and toolmakers. Although unemployment studies and statistics indicate that many of those who are unemployed are classified as skilled workers, company executives have found that few have the experience and qualifications required by those industries which have already had a sharp expansion in production.

A few months ago, industry in the United States was given its biggest job of all time—to so arm America that invasion of this hemisphere would be a military impossibility. Industry's answer was, "We will do our job and do it on time."

Although many companies operate apprentice programs with good results, the skilled labor market has rapidly dried up and management is faced with the problem of training men and training them rapidly. As production expands, it is often possible to reorganize and break down skilled operations. In a relatively short period, new or unskilled employees can be developed and trained to perform one or two operations which are normally part of a skilled job. Unskilled employees may become qualified to perform particular hand operations on types of work on a single machine by intensive training on the job, supplemented, in some cases, by home study, classroom or individual instruction. Such intensive training programs usually are not introduced until the jobs have been broken down, thus making the skill required less exacting.

Such analysis will prepare the shop to receive a large number of new men. Industry will benefit by getting the greatest value from the existing supply of skilled labor. Learners can be shifted about so that eventually they may qualify as skilled craftsmen.

These learners will be:

Men in your own plant who can be shifted from a simple to a more complex machine; high school graduates with or without trade school experience; older men who have some machine tool experience but whose experience is so far back as to evidence only mechanical aptitude; and older men with no mechanical experience.

Learner candidates may be easily secured, so the most important step is to prepare the training program. The

burden of this program rests upon the instructors who fall into three general classes:

1. Instructors whose sole job is to teach.
2. Foremen.
3. Skilled workmen.

Undoubtedly the best choice is to provide an instructor who is skilled in imparting knowledge, whose sole job is to increase the skill of the learner. Where this is not possible, the job may be left to the department foremen, or delegated to a skilled workman to train each group. As the majority of these men will probably have had little or no previous teaching experience, much thought can well be given to selecting and developing the instructors. They may know their subject, but the method of imparting it to someone else must be acquired.

Whenever there is an urgent demand for skilled or semi-skilled men, there are a number of considerations and steps which must be considered prior to the actual setting up of a training program.

The first essential is to have a definite knowledge of the anticipated production schedule in terms of man power: How many employees will be needed? When? What education, skill, and experience is required?

In addition to this information it may be desirable to have complete data on all present employees. It may be that some present employee can be used to advantage for training on higher skilled work.

An emergency program, such as this, usually has two objectives:

1. To qualify new or unskilled employees for specific semi-skilled jobs.
2. To continue the training of promising semi-skilled workers or learners which will enable them to qualify for higher skilled and more responsible jobs.

To prepare a program to meet the need for training men quickly and thoroughly on special jobs, a sub-committee on Specialist and Machine Operator Training was appointed by the Chicago Branch, National Metal Trades Association Committee on Training Employees for Industry.

At a meeting of this Committee the requirements which any program must meet were laid down. Accordingly, training programs should be:

Practical and simple
Adaptable for use in plants of any size
Permit addition of other classes of specialists
Easily administered by management with as little outside help as possible
Low in cost
Logically arranged for use
Arranged to outline the procedure for training by foremen and others who previously did little or no instruction work
Adaptable for instruction on production work
So-called "projects" should be avoided

With this as a guide, the Committee reviewed the available material and proposed an outline form, the purpose of which was to assist those who have to do with shop training, to recall exactly what the new man needs to know. Instruction outlines, which were prepared for many metal-working occupations, serve as a check list of instruction points which must be covered if the learner is to qualify thoroughly on his job: Machine Description, Machine Controls, Nature of Operations, Loading Work, Care of Machine, Operation Details, Coolant—how, when, and why used, Gaging, Safety, Removing Work, Tools, Tool Grinding.

However, the outlines must be supplemented by the following to make the training program effective:

1. Instructors who know the job
2. Adequate training material
3. Estimates as to the time ordinarily required to learn specific jobs, as a standard of comparison
4. Records of individual progress
5. Fair compensation during the learning period

These essentials make the difference between "picking up" a job and learning a job under capable instruction. Effective training goes further than merely teaching the new man how to do his work. It should include explaining company policies, promoting cooperation and building good will.

Effective training should answer two basic questions: What does the learner need to know? What is the best way to tell or show the learner what he needs to know?

Firstly, any person who has become proficient over a period of time, is likely either to overlook some of the essential details of his job when he is explaining them or to assume that the learner already knows them, because the details seem so obvious. Whenever, therefore, the person who is responsible for training takes the time to analyze the job in terms of what the learner needs to know and sets those things down to make sure the instructor does not overlook them, a better instruction job will be done.

Secondly, the instructor should see that each learner has access to, or is furnished with, the reference material suggested in the outline. The references in *Machine Shop Technology*, published by the National Metal Trades Association, furnish excellent general information on the uses of the machine tool and its operation; those in manufacturers' books give information on the specific machine; and the plant safety rules, to which reference is also made, should cover the policy of the company with regard to safe practice.

In explaining how a job is to be performed, shop instruction sheets have proved valuable. These instruction sheets should specify the sequence in which each operation is to be performed, the way to do it, the tooling to use, and other important information.

The outlines show the essential instruction points, in each job classification, which should be explained or demonstrated to the learner. Experience has indicated that the most effective use of this material will be secured if the following suggestions are followed:

1. List the jobs where it is necessary to train men, and estimate the approximate training time.
2. Analyze your personnel and select as instructors one or more employees who know most about these jobs and who seem best qualified to instruct. (A good workman is not necessarily a good instructor.)
3. Place a copy of the manual or of a specific outline in the hands of each person selected to act as an instructor.
4. Ask them to study the outline and give some thought as to just how they will explain and demonstrate these points (or any other points they think essential) to a learner.
5. Arrange for meetings of the instructors to discuss how to use the outlines and how to put across instruction effectively.
6. See that all persons who are to act as instructors understand and are familiar with the reference material shown in each outline.
7. Be sure the instructor does not attempt to tell the learner too much at one time.
8. Start inexperienced men on the simplest class of work available in an occupation. Advance them, as they acquire skill, to perform more difficult work.
9. Give a copy of the instruction outline to each learner, covering his job, and see that he gets and uses the reference material.

The National Metal Trades Association developed these outlines particularly for the plant which cannot set up a separate training department, for foremen, for employees selected as instructors and learners themselves. While they are adaptable to any job classification, the instructor should supplement them by pointing out important points which are peculiar to the job in the individual plant.

Spun Shapes

By V. A. McCHESNEY AND R. J. SALISBURY, ALUMINUM COMPANY OF AMERICA

Using hand tools of a variety of shapes, a skilled operator can produce spun articles of uniform size in complicated forms without expensive dies

SPINNING is one of the oldest metal-working arts, and has been used in making circular hollow ware for many years. While largely replaced by drawing for large-scale production, it is still widely used when tool costs must be kept low, as well as in the manufacture of products which cannot be drawn because of their size or design.

Since the metal is formed over a chuck rotating in a lathe, the process is limited to symmetrical articles that are circular in cross sections normal to the axis of rotation. Typical spun items are cooking utensils, lighting reflectors, processing kettles and ornaments of many types.

With an experienced operator, spun articles can be held to reasonably close dimensional accuracy and will be uniform in size and appearance. However, spinning is truly an art, and the skilled craftsman can spin complicated shapes that the ordinary mechanic would find impossible to produce.

Most spun products are made from one of the common alloys of aluminum or commercially pure aluminum (2S), which is more easily spun than any of the aluminum alloys. An aluminum-manganese alloy (3S) is often used because it has greater strength than pure aluminum. Unlike 2S, it requires intermediate annealing on deep spinning, as well as more breakdown operations. Occasionally 52S and the heat-treated alloys are spun, but may have to be annealed more often because of their greater rate of strain hardening.

In choosing a blank size, it should be remembered that the finished article is always somewhat thinner than the circular blank, even with the most careful spinning. Allowance should therefore be made for this reduction when selecting the thickness of metal to be used. By using several breakdown operations, however, the thinning can be minimized.

Fig. 6—The half-round spinning tool held by the operator is used for intermediate and final shaping. At the left is a beading tool for turning the edge of the metal. A diamond-point trimming tool is shown in the center and another half-round tool stands at the right

The area of the starting blank should be equal to the surface area of the finished product. Since the blank decreases in thickness during spinning, and therefore increases in area, this will allow for the necessary trimming.

In the spinning operation the circular blank is placed in a suitable lathe and held by pressure against a chuck which has the exact form of the interior of the desired object. The lathe, chuck and blank rotate at a high speed. A hardwood stick or wedge is used to break down the blank, and a "half-round" forming tool (usually made of a steel rod) is used to lay the metal down on the rotating chuck. Typical hand tools used by the operator are shown in Fig. 6.

The lathe speed is determined by the thickness and diameter of the blank as shown in Table 10. Generally, the lathe should have at least three speeds, such as approximately 1,200, 700, and 250 r.p.m. The lower speed applies to large items and thick sheet. Each operator will have his preferences as to proper speeds; those given in the table simply serve as a guide.

The spinner should observe certain precautions. For example, it is imperative that a flange be maintained on the outside of the "spinning" at all times, even up to the final trimming operation. If wrinkles appear in this flange, the "spinning" should be taken from the chuck, and the flange hammered smooth. Wrinkles should be

Fig. 7—Sectional chucks are used when the products are so shaped that a solid chuck could not be removed after the final operation

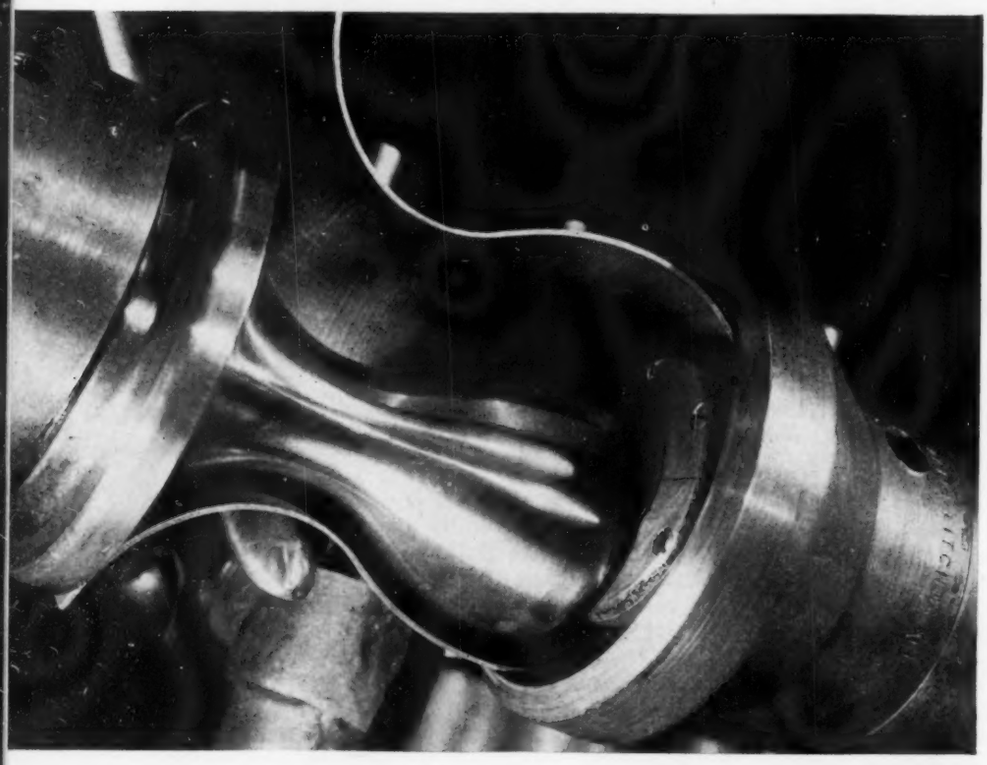


Fig. 8—This cut-away view shows a cuspidor being spun over an off-center chuck or roll by hand spinning after the shell had been shaped by a preliminary draw. For quantity production, rolls are preferred to chucks

removed as soon as they are noticed since they cannot be spun out.

While spinning, the operator is able to feel the metal "flow" beneath the tool. If the metal becomes too hard to "flow" properly, the workability can be improved by heating with a torch while the shell is rotating in the lathe. However, the metal cannot be fully annealed by this method. If it is necessary to fully anneal, the metal should be heated to a temperature of 650 to 750 F. The work should be removed from the chuck to carry out this operation successfully. When the proper temperature has been reached, a pine stick rubbed on the metal leaves a charred mark. Annealing with a torch is especially adapted to larger items. In all cases, however, a fast method of heating should be used so as to prevent grain growth. Immersion in molten nitrate bath at 650 to 750 F. is satisfactory for small articles. The time of heating varies from 30 sec. to several minutes, depending on the metal thickness.

The number of spinning chucks (or the number of reductions) depends on the shape of the finished product, as well as its diameter compared with that of the blank. In general, shells with perpendicular sides require more chucks than those with sloping sides.

Final Spin Laid Tight

After the breakdown operations are all completed, a "final spin" is made to lay the shell tightly against the chuck, starting at the tail stock end of the lathe and working outward. As he proceeds, the operator should make sure the metal is not loose at any point. When the metal is not tight against the chuck, it makes a hollow sound when tapped with a wood mallet. It is almost impossible to lay a loose intermediate section to the chuck if there is a tight fit at both ends.

After spinning, hemispherical shells will have a flat bottom equal in diameter to that of the back-up block. This flat area can be hammered out to whatever radius or shape is required.

There are certain differences between spinning lathes and those used for woodworking. The headstock bear-

Table X—SPEEDS FOR SPINNING ALUMINUM ALLOYS*

Blank Diameter, Inches	*Thickness of Metal, Inches*	*Temperature of Metal, Deg. F.*	*Lathe Speed, R.P.M.*
36 to 72	3/16 to 3/8	400 max.	50 to 250
24 to 36	12 gage to 3/16	Room	250 to 550
12 to 24	20 to 12 gage	Room	400 to 700
Up to 12	20 to 16 gage	Room	600 to 1,100

* Lathe speed is affected by the weight and condition of chucks. Generally, the greater the speed, the easier it is to spin aluminum alloys.

ing should be larger and should be fitted with a more efficient thrust bearing because of heavier pressures. Lathe size depends, of course, upon the size of blanks used and depth of shells spun. A coarse pitch on the tailstock screw helps in removing the completed product.

Chucks may be made of aluminum alloy, steel, cast iron or hardwood, depending on the quantity and quality of the work. Hardened steel chucks with a high polish produce smooth surfaces and are most economical for products that are buffed or given a similar finish. Imperfections in wood or cast iron chucks show on the inside finish. This is caused by the high pressures used. Wood chucks may be cheaply built with laminations so that the contour is readily changed. Large items are generally spun over inexpensive wood chucks.

Chucks can be built in one piece unless they are partially enclosed by the shell. In such a case the chuck may be made in sections, as shown in Fig. 7. The sections should fit perfectly or an offset at the joint will be impressed on the "spinning." An off-center chuck, Fig. 8, which comes in contact with the work only at the point of spinning, also may be used. This off-center chuck (or roll) does not have to be assembled and disassembled and therefore saves time. However, spinning cannot be done near the bottom, and the spun product must have an opening large enough for removal of the entire chuck. If an off-center chuck is used, the bottom of drawn shells may first be formed by a bulging operation.

Fig. 9—Blanks up to 88-in. diameter can be spun in this lathe. In this case the tool is supported by screw-operated slides which are motor driven. Spinner's helper in the foreground is keeping the tool lubricated with ordinary laundry soap

"Spinning on air" is a higher branch of the art in which no chucks are used. The inside of the shell is supported only by means of a hardwood wedge held by the operator.

The hand-spinner generally uses a hickory stick for breaking down the circular blanks. A forged steel forming tool is used to lay the metal on the chuck. While forming tools vary with the operator and the spun item, a ¾-inch diameter rod with one flat side and one round side is suitable for most products. Special tools are needed for trimming and beading. Spinning tools may be mechanically supported when large shells or thick metal is spun. Fig. 9 shows a spinning lathe which will take 88-in. diameter blanks, and has a power-operated tool holder.

Ordinary laundry soap is the most practical lubricant, especially for larger items, and is applied to the blanks before and while spinning.

The fifth article in this series on the cold working of sheet aluminum will appear in an early issue.

Do Profit Limitations Save Our Money?

MANY well-intentioned citizens and legislators get their wires crossed when they think of war profits. They are filled with righteous indignation at those who made fortunes while millions were suffering during the last war. They commendably want to prevent its repetition. And so, quite naturally, they try to limit profits on war materials.

The Army and Navy set limits of ten and twelve per cent on certain supplies, believing that in this way they can secure low prices. But it does not always work out that way. With a fixed return based on cost plus a given per cent, there is no financial incentive to improve methods and reduce manufacturing costs. In fact, the higher the cost the greater the profit.

A careful study of the problem forces one to the conclusion that it might be wise to waive all such restrictions, except on experimental and developmental work. Without such limitations the profit incentive leads to more economical designs and methods. If excessive profits accrue as a result, income and excess profit taxes can be depended upon to reduce the net to a fair figure. Unless prices are pegged at artificial points, by law or by trust agreements, competition will keep them within reasonable limits.

IDEAS FROM PRACTICAL MEN

Tools for Making Ring Clamps

BY CHARLES H. WILLEY

It may be of use and interest to describe how ring clamps for mounting flush-type meter rings *A* are made from strip stock. There are many uses for such rings and the tools shown permit making a variety of ring diameters with no changes. The diameters are limited only by the length of strip used.

Fig. 1 shows the ring and its uses. It is made of $\frac{3}{64}$x$\frac{3}{8}$-in. semi-hard strip brass. After cutting the strip to desired length, the ends are bent at right angles, as indicated by the dashed lines on the simple fixture shown in Fig. 2. The end of the strip is inserted into the slot *B*, and the handle is turned until it hits the stop pin *C* to bend the stock.

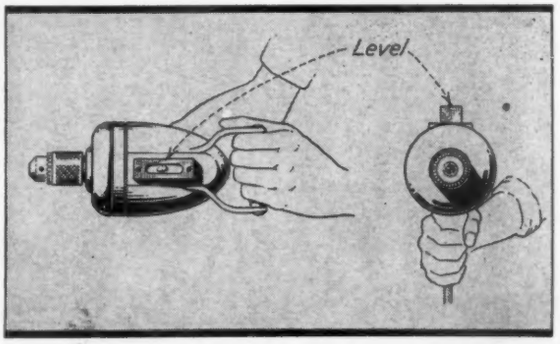
The circle is formed as shown in Fig. 3. The stock is hooked against the pin *D* and is bent around the disk *E* as shown; the same thing is done from the other end of the stock. Since the disk is much smaller than the diameter of the required ring, the natural spring of the formed ring gives it about the diameter needed. Various diameter disks can be used for different rings when necessary.

Fig. 4 shows the tools used to punch holes *F* in the end of the rings, and to form and punch the lugs *G*. The tools are mounted in a self-aligning die set which has rubber blocks between the upper and lower halves of the set. A separate shank in the press ram is used to operate the die set. The die is secured to the bolster and the stroke is adjusted to have the shank meet the top half of the set and force it down sufficiently to cut the lugs *G* and punch the holes in them. The rubber blocks compress and as the ram raises the rubber blocks raise the top half of the set. The lugs *G* are forced out of the strip at Station *H*, while the lug holes are punched in them at Station *J*. The end holes *F* are punched at Station K. As shown each punch is surrounded by a stripper.

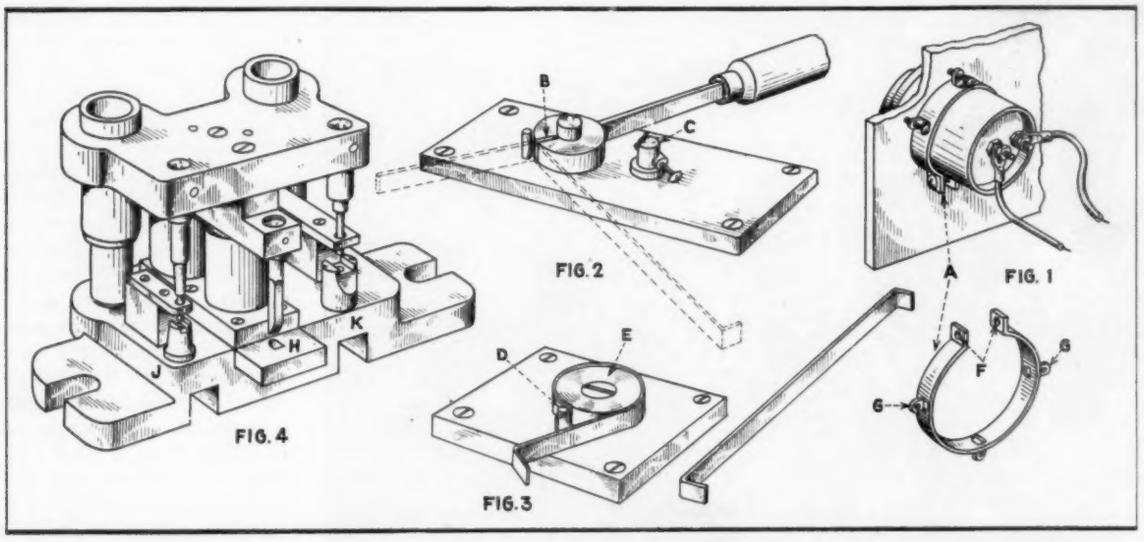
Level Aids in Drilling Straight Holes

BY FRED MUELLER

In our shop, engaged in the production of aircraft parts, we had considerable difficulty in drilling straight holes with electric hand drills. To overcome this difficulty, we weld to the flat top of an electric hand drill



A small level welded to the flat top of an electric drill will enable the operator to drill straight holes



Rings for flush-type meters can be formed with these tools. They permit making a variety of ring diameters with no changes in design; the diameters are limited only by the length of stock used

a level, which enables the operator to keep the drill horizontal with the work. Both experienced and inexperienced men find it easy to make straight holes with drills so equipped. It certainly has helped to increase production in our shop.

Measurement of Coatings on Curved Surfaces

BY H. T. COATES

Following is a method for measuring the thickness of soft plated coatings on curved surfaces. It does not involve the use of a grinding wheel or a file.

For a curved surface of known radius I use a carefully made scraper that is accurate as to straightness. The metal coating is scraped down to the base metal and the chord of the straight portion is used to calculate the thickness of the coating. The advantage of this over the file is principally that any effect of rocking, which may be great with a file, is entirely eliminated with a scraper. In the case of a curved surface, any rocking of this scraper while in motion takes off as much on one side of the scraper as is added to the other, and measurements are accurate in spite of it.

In calculating the thickness of the coating, I use the formula.

$$T = \frac{C^2}{8} \times \frac{R_2 - R_1}{R_2 \times R_1}$$

where R_2 is the radius of the cylinder on which the coating is being measured, R_1 is the radius of the circular scraper, and C is the cord subtending the arc scraped out—the chord across the scraped section is measured by dividers and the measurement read on a scale reading in hundredths of an inch. With this, it is possible to measure as close as 1/200 of an inch.

The advantage in using the scraper method herein described is that it requires no guides or clamps, and can be used readily in the field with tools that can be carried in the vest pocket. Its accuracy is such that it gives the thickness of the coating less than 10 per cent in error. I refer to engineering tables of half chords in working up tables for the particular radii I commonly use, or have taken natural sines and the corresponding versines, the sine being the half-chord and the versine being the coating thickness.

Brazing Locomotive Driving Boxes

BY JOHN DEERING

One of the most important railroad welding jobs is the often tried but seldom successful practice of welding bronze hub faces on locomotive driving boxes. But our driving boxes with bronze welded faces have been in service over 200,000 miles, and have shown minimum wear.

We keep the applied metal for the hub liners down to a minimum thickness, generally not over ½ in. This is accomplished in the preparation of the box for welding. In the event that the box is an old one

This locomotive driving box with a bronze-welded hub face has given over 200,000 miles of service. The wear was 3/32-in. A 5/32-in. layer of bronze is being added to bring the face back to size

or has been grooved for a poured liner, the groove is welded level with the top of the box and additional metal is added until the box is approximately ½ in. under the finished size. We use ⅜-in. coated rod in building up the foundation for the bronze hub face. The hub face is then welded as follows:

A strip of $\frac{3}{16}$x½-in. steel is bent to the shape of the box and tacked to the outside of the hub face to act as a dam for the molten metal; this strip is kept as near as possible a true circle in order to aid the boring mill operator in machining this strip from the finished box. If the crown brass is not in place when the box is brazed, a similar strip should be placed on the inside of the box for the same purpose. The crown brass can then be machined to fit this circle perfectly.

The driving box is quite a mass of steel; therefore, a large welding tip must be used, usually one with a ⅛-in. orifice or larger. The large welding companies interested in this application have been constantly on the alert to produce a bronze rod suitable for this job, the most recent being a cast ½x⅛-in. rod. However, we have obtained satisfactory results with ordinary bronze welding rod. No attempt is made to speed up this operation and while a much larger tip could be used to fuse the bronze to the box all concerned are satisfied with the present results. When the box is sufficiently hot the operator will use up to three of these ½-in. rods or four of the $\frac{3}{16}$-in. type, taking care at all times not to burn the bronze into a gummy porous mass. When the crown brass is pressed in place these boxes are faced and bored leav-

ing a hub face free from holes and good for many thousand miles of service; in fact, it is not uncommon to have to press in new crown brasses before the hub surface shows signs of wear.

The box being welded in the illustration is in the shop for its third crown brass. The hub faces of this box and the balance of the set were worn a maximum of $\frac{3}{32}$ in. Therefore a $\frac{5}{32}$-in. layer of bronze is welded to the previously applied surface.

Quick Clamping of Work With Small Holes

BY EUGENE GROSZ

When the work has to be clamped using a stud through a hole, there are instances when the size of the hole is too small to allow the use of a slip C-washer. In such cases it is always necessary to remove the clamping nut altogether when unloading

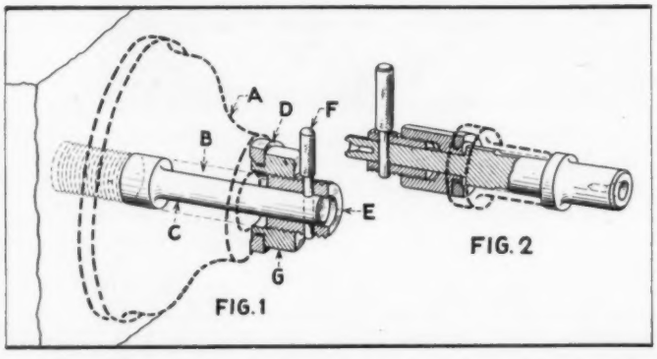


FIG. 1

FIG. 2

This quick clamping device makes it unnecessary to move the clamping nut completely from work mounted over a stud or bolt on a fixture

the work from the fixture. Thus both loading and unloading becomes a delayed process.

Considerable time can be saved by the following expedient: Referring to Fig. 1 work *A* is clamped by placing it through the hole *B* over the stud *C*. A washer *D* is slipped on with a threaded bushing *E*. Placing pin *F* in its place as shown, a fraction of a turn on the nut *G* clamps the work. When unloading, a slight twist of the nut *G* allows the pin *F* to be pulled out easily.

Fig. 2 shows the adaptation of the same principle to a grinding arbor.

A Holder for Grinding Tool Bits

BY JOHN W. GERDEL

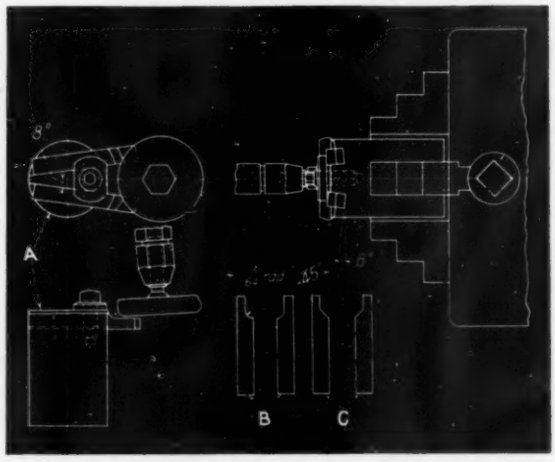
A number of toolbits were to be ground to round the corners of the crankshaft bores of piston rods for model *A* Fords and to chamfer the same corners for the rods for Chevrolets. Both ends of the bore were faced and chamfered at the same time, which required right- and left-hand chamfering tools. As it was a production job, the radius of one and the angle of the other were held to close limits. The cutters had been previously ground by hand with the result that after they had been ground several times on the face they lost their shape. The illustrated holder was made to overcome this difficulty.

The holder was made from a piece of $1\frac{1}{2}$-in. round steel *A* which was faced square on an end. Two $\frac{5}{16}$-in. slots were milled in the faced end of the holder at 8 deg. either way from a center line, while the piece was held at 6 deg. for one side and 6 deg. in the opposite direction for the other side. The tools were roughed out by hand to approximate shape before they were placed in the device.

The holder was trued up in a lathe chuck. The tools were clamped in the device. A toolpost grinder was mounted in the lathe, and a rather hard wheel was placed in the chuck of the grinder. The corner of this wheel was dressed as nearly as possible to $\frac{9}{64}$ in. radius for forming the cutting edge on tools *B* for the Ford rods.

The wheel was fed into the work, while the lathe was turning, until the full quarter round appeared to have been cut. It was then measured with a $\frac{9}{64}$-in. radius gage. The wheel was dressed where the light showed through. This was repeated several times until the quarter round was a good fit on the gage. The final cut was taken while the lathe was pulled around slowly by hand. This made a smooth clean cut.

The tools *C* for the Chevrolet rods were made in much the same way except that the corner of the wheel was dressed to a 45-deg. angle and the compound rest was used to finish the 45-deg. angle.



Right- and left-hand chamfering tools were ground accurately in this toolholder mounted in a lathe chuck. With the lathe turning, the grinding wheel mounted in the toolpost was fed into the work. The toolbits were roughed out by hand to approximate shape before finish grinding

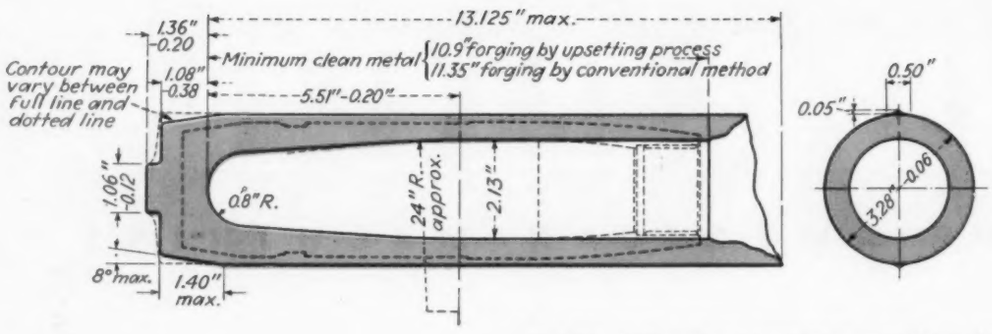
The tools that were ground in this device could be used until they were so thin that they would break, but they would retain their shape until the last.

Armament

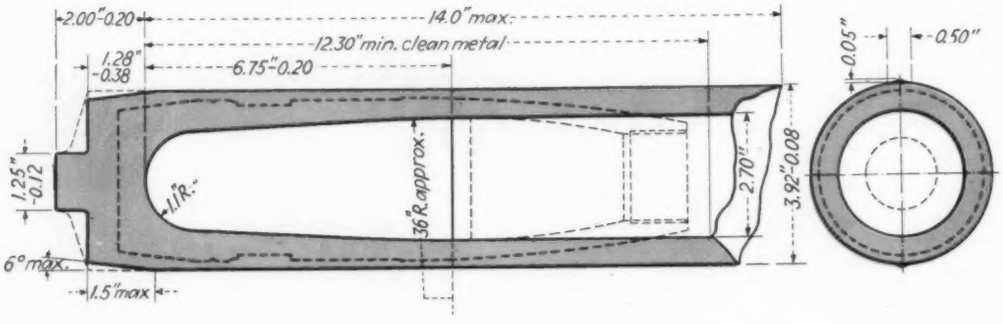
SECTION OF AMERICAN MACHINIST

Tooling Set-Ups for High Explosive Shell

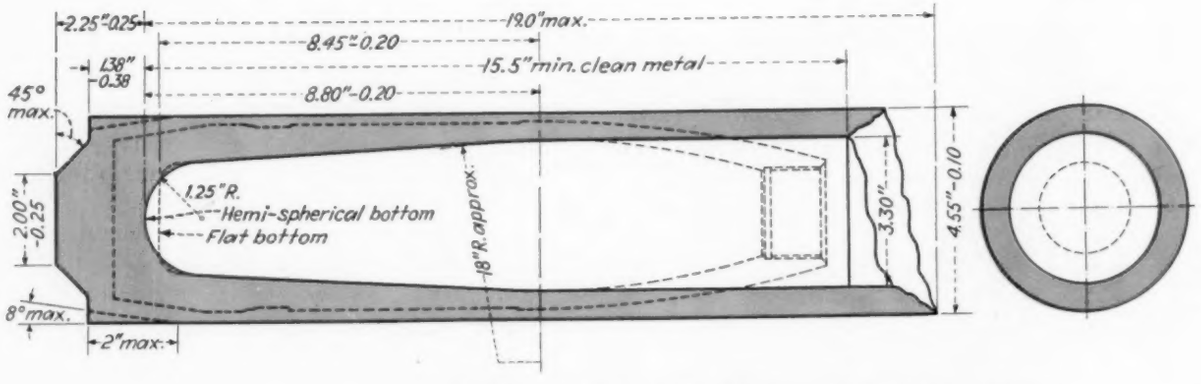
It's no longer debatable whether or not we are to rearm, or whether or not we are to aid Great Britain. The question is how. Tooling and manufacturing methods take topmost priority in current planning. To meet the urgency for quick action the following carefully compiled data are sure to be helpful



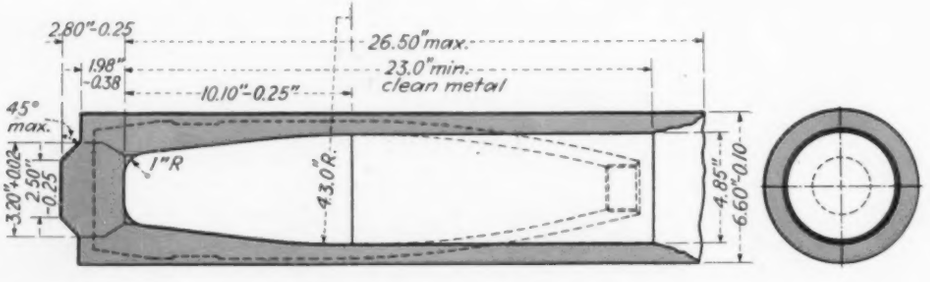
A—Steel Forging for 75-mm., M48, H. E. Shell



B—Steel Forging for 90-mm., M58, H. E. Shell



C—Steel Forging for 105-mm., M1, H. E. Shell



D—Steel Forging for 155-mm., M101 and M102, H. E. Shell

TOOLING SET-UPS FOR HIGH EXPLOSIVE SHELL

Industry's biggest task in rearmament is the mass manufacture of shell. Model methods for this purpose have been developed, but prompt action depends on the maximum use of existing equipment or, at least, on a combination of new and old machines. In the pages that follow, optional methods for each operation together with their tooling are fully described

By BEN C. BROSHEER
Associate Editor, American Machinist

AMERICAN INDUSTRY must produce within the next two years full equipment for a modern, mechanized army of 2,000,000 men on a combat basis, and also must manufacture huge amounts of war materiel for the British. Ammunition in astronomical quantities will be necessary. In terms of man-hour and productive-capacity requirements, the manufacture of high-explosive artillery ammunition in anti-aircraft and other medium-caliber sizes is the major task ahead of American metal-workers. They will be called on to make millions of high-explosive shells for the British and American armies.

It is anticipated that the shell sizes needed in the largest quantities will be the 75-, 105- and 155-mm. high-explosive and chemical shell, the 3-in. and 90-mm. anti-aircraft shell, and the 60- and 81-mm. trench mortar shell. One of the principal items probably will be the 105-mm. howitzer shell. Some recent estimates show that more than two-thirds of the shell in these sizes will be made from steel forgings, a few from tubing, and some from steel castings.

Some appreciation of artillery ammunition requirements can be gained from the fact that, while the so-called "day of fire" for a 75-mm. gun is 300 rounds, a gun battery *can* fire three or four times that in heavy fighting. This approximates 25,000 rounds per day for a gun regiment. Larger field pieces have rates of fire about half those of the 75-mm. gun, but still require enormous amounts. Anti-aircraft guns can fire as high as 25 rounds per gun per minute; infantry mortars can be and are fired as fast as they can be loaded.

To keep German raiders high enough that their bombing was inaccurate, London's defense guns are reported to have pumped out 700,000 anti-aircraft shell a day during last September. And this does not include countless machine-gun cartridges. Even under 1918 conditions, a 250,000-man field army was estimated to use over two billion dollars worth of ammunition a year. In the Battle of the Somme during the World War the British forces alone fired more than four million rounds!

Fig. 1—These finish-forged-cavity forgings for U. S. Army high-explosive shell are made from high-sulphur, high-manganese steels. Maximum eccentricity permitted between cavity and the exterior cylindrical surface ranges from 0.0625 in. for the 75-mm. shell to 0.093 in. for the 155-mm. size. A tolerance of +0.02 in. is permitted at any portion of the interior cavity for the shell shown

Shell Program to Move Fast

To get the shell production program under way quickly American industry will, in many instances, have to make use of equipment already installed. Ingenuity in making improvizations will be called for in order that economic production can be obtained at an early date. As more modern high-production equipment becomes available it can be installed to take full advantage of any obvious economies.

both in cost and time. But the need for the present is to get the production program rolling.

Today's conditions are but little different from those faced by the American metal-working industry early in the World War, when many plants accepted contracts to make huge quantities of shell for the British, French, Italian and Russian armies. Reference to articles published in *American Machinist* during the war years shows that there was a wide variation in methods used, even for similar sizes and types of shell. Some plants found the engine lathes of that day inadequate for heavy turning and boring operations on steel shell and either rebuilt them to suit the work or designed and built special machines for shell operations.

Even in '15, '16 and '17 there was a wide divergence of opinion as to the relative merits of reducing each operation to its simplest terms, or of putting as many operations as possible upon one machine. Some plants subdivided shell machining operations as far as possible and provided machines for each subdivision, others used turret lathes and boring mills for groups of operations with a single set-up.

The same two schools of thought exist today. And there again will be many differences between methods of performing similar operations. Some of these variations will be due to local conditions, to the ability or inability to secure certain types of equipment, and to the quality of the forgings supplied to the machine shop; other variations will be due entirely to honest differences of opinion as to the best way to do a given job. In the end, however, more shell will have been produced at the end of any given period, and their cost will have been less, than if all shops attempted to make shell by any "one best method."

A review of European experience along this line should be of value to those who are to be responsible for shell production in the United States. For instance, it is understood that the Germans are using a special multi-tool machine, powered with a 150-hp. motor, that turns out a completely machined 6-in. shell every 30 sec. Many multi-tool units of American and European manufacture are used for machining shell in British, Greek, Italian and German plants at the present time. Huge quantities of French shell also were machined in such units. It is reported that the German-designed Hasse & Wrede shell turning machines, which are powerful units employing a multi-tool set-up, are very popular in Germany and in England.

What Is a High-Explosive Shell?

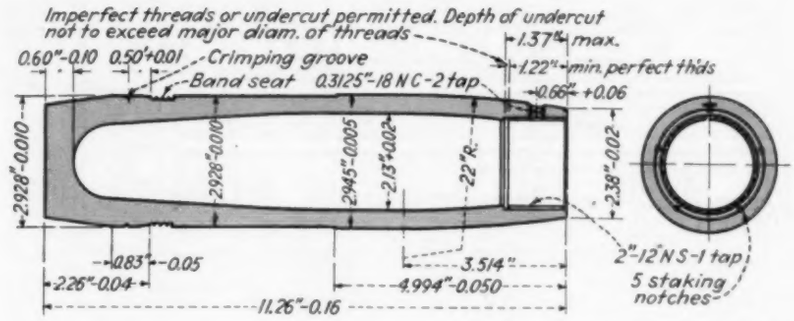
Essentially, a round of high-explosive ammunition of the sizes shown in Figs. 1 and 2 consists of a steel shell, a fuze and booster to detonate the high-explosive charge in the shell cavity, a cartridge case containing the explosive propelling charge, and a primer in the base of the cartridge case which serves to ignite the smokeless-powder propelling charge. Each of these units must be made to close tolerances if the artilleryman's demand for a shell that is safe to handle, accurate in flight and efficient at the target, are to be satisfied. For the present, only the problems involved in the production of the steel shell bodies will be discussed.

Men familiar with all types of American and European shell are, for the most part, in agreement that present-day U. S. Army shell are simpler in design, hence can be machined more rapidly with less expensive tool set-ups, then most other shell of comparable sizes. U. S. Army shell specifications now call for high-sulphur, high-manganese steels, even though manganese may in the future be difficult to obtain. The free machining characteristics of these steels make them especially desirable where a large

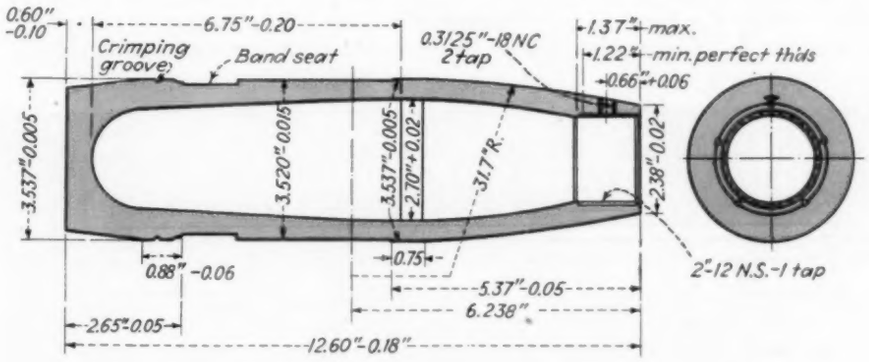
Table I—SPECIFICATIONS FOR HIGH-EXPLOSIVE SHELL

Shell Size	*Mark*	*W. D.-Steel Spec. No.*	*Minimum Yield Point Lb. per Sq.In.*	*Minimum Elongation Per Cent in 2-in.*	*Minimum Red. of Area Per Cent*	*Maximum of Weight Forging Pounds*	*Weight of Finished Body-Empty Pounds*	*Mean Vol. of cavity to overflowing Cu.In.*
60 mm.*....	M49A2	X1314	40,000	15	30	3.33	1.60	8.85
75 mm.....	M48	X1340	55,000	15	30	20.0	10.75	32.42
3 in.....	M42	X1335	45,000	15	30	.....	9.28	21.83
81 mm.**...	M43A1	X1314	35,000	15	30	6.38	3.94	24.0
90 mm.....	M58	X1340	55,000	15	30	31.6	15.46	53.5
105 mm.....	M1	X1335	40,000	15	30	53.9	25.50	90.0
155 mm.....	M101	X1340	60,000	15	30	150.0	74.26	280.0
155 mm.....	M102	X1340	50,000	15	30	150.0	76.55	280.0

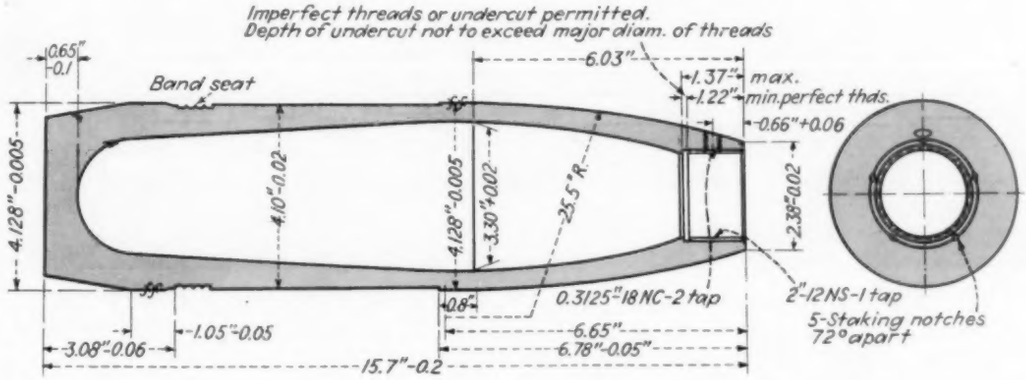
* Trench mortar shell. May be made from steel forgings, castings or from specially rolled steel plate, cupped and welded longitudinally.
** Trench mortar shell made from steel forgings.



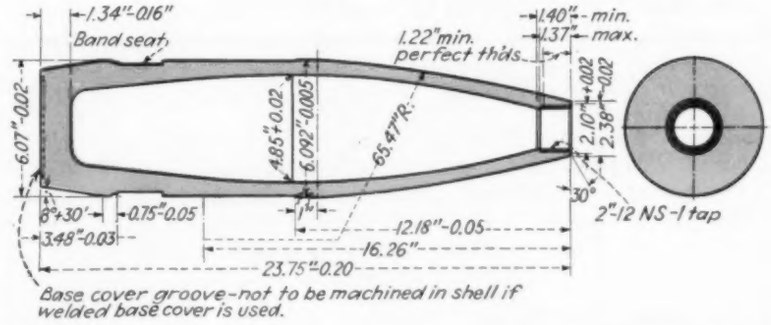
A—Finish-machined 75-mm., M48, H. E. Shell Body



B—Finish-machined 90-mm., M58, H. E. Shell Body



C—Finish-machined 105-mm., M1, H. E. Shell Body



D—Finish-machined 155-mm., M101, H. E. Shell Body

Fig. 2—These high-explosive shell all have the same size of thread in the nose. Details of operations necessary to machine shell to these finished sizes from forgings shown in Fig. 1 are discussed in the following pages. Dimensions for which no tolerance is given are not habitually gaged

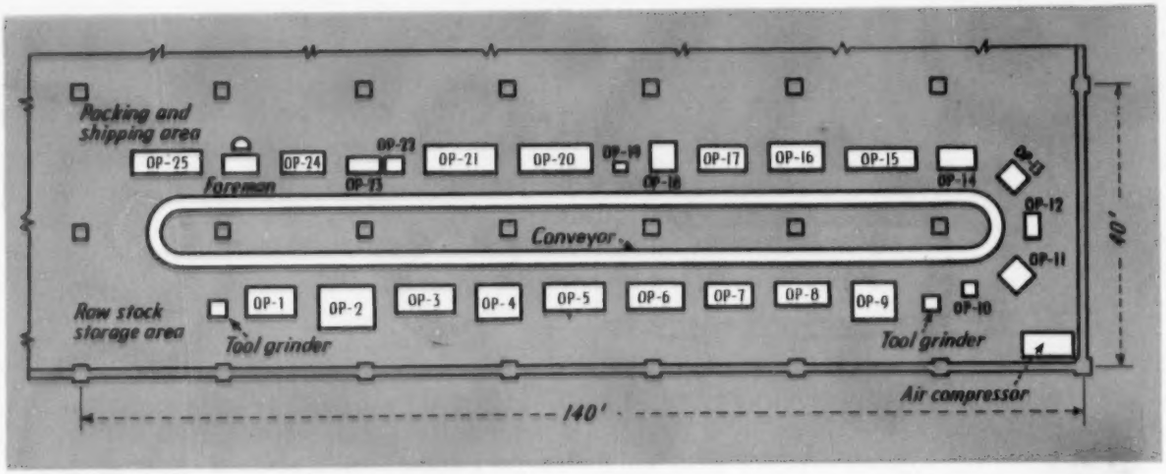


Fig. 3—This floor plan has been developed for the operations on 75-mm., M48, high-explosive shell using equipment suggested by W. C. Lipe, Inc. A variation of this layout, using a straight conveyor line, is shown in Fig. 4. These set-ups will produce 342 shell per eight-hour shift

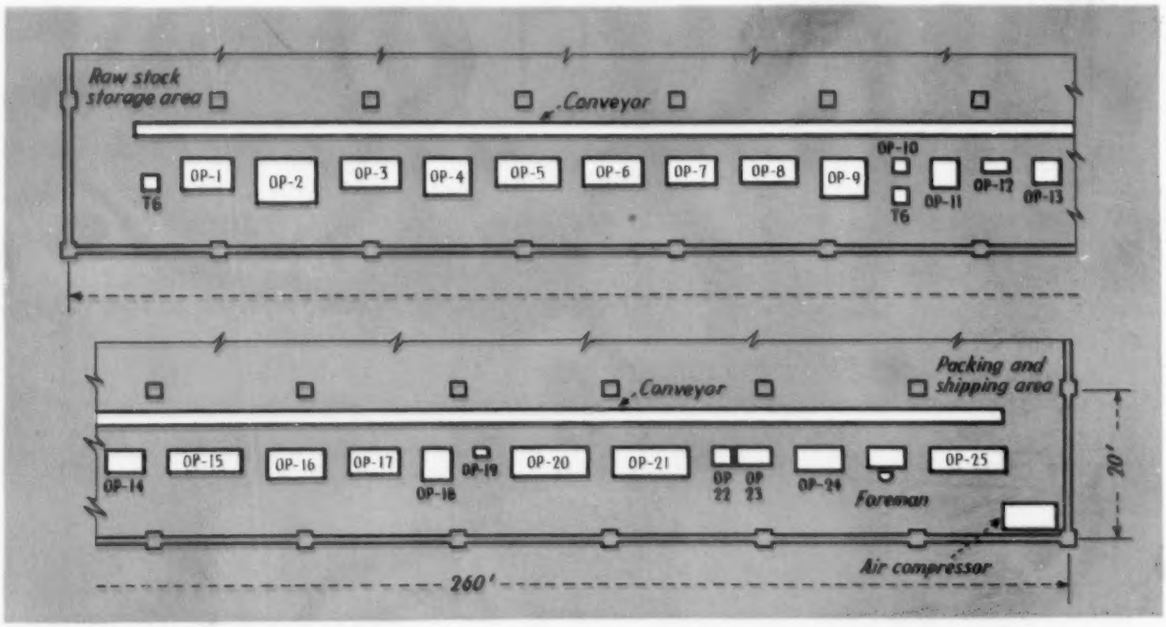


Fig. 4—Incorporating the same equipment shown in Fig. 3, this layout permits easy access to all units, but requires twice as many conveyor dollies. Estimates show a production rate of one shell every 70 seconds

Table II—SIZES AND WEIGHTS OF HIGH-EXPLOSIVE SHELL

Shell Size	*Mark*	*Length of Body Inches*	*Diameter at Bourrelet Inches*	*Weight of Finished Body Pounds*	*Weight of Rot. Band Pounds*	*Weight of Cover Plate Pounds*	*Weight of Setscrew Pounds*	*Total Weight Empty Shell Pounds*
60 mm.*	M49A2	5.01	2.362	1.60	None	None	None	1.60 ± 0.05
75 mm.	M48	11.26	2.945	10.75	0.17	0.04	0.01	10.97 ± 0.30
3 in.	M42	8.43	2.995	9.28	0.46	0.04	0.01	9.79 ± 0.20
81 mm.*	M43A1	7.43	3.175	3.94	None	None	None	3.94 ± 0.13
90 mm.	M58	12.60	3.537	15.46	0.66	0.05	0.01	16.17 ± 0.30
105 mm.	M1	15.70	4.128	25.50	0.47	0.06	0.01	26.04 ± 0.40
155 mm.	M101	23.75	6.092	74.26	2.25	0.48	None	76.99 ± 1.10
155 mm.	M102	23.75	6.092	75.31	0.76	0.48	None	76.55 ± 1.10

* Trench mortar shell.

quantity of shell must be produced in the shortest possible time, as is the case today.

Heat-treatment of shell, a major problem during the last war, will not be necessary today for the sizes listed in Tables I and II, except for the 155-mm. gun shell which requires a yield point of 60,000 lb. per sq.in. Only if variations in physical properties are encountered in practice will it be necessary to resort to heat-treatment of other sizes in the 75- and 155-mm. range, as it is believed that an ample factor of safety is provided in the steels now specified.

Many of the problems faced by the machine shop in the production of shell can be reduced or eliminated in the steel mill and the forge shop under proper control of operations. When forgings are made accurately, leaving little stock for machining, roughing operations can be reduced to a minimum, and the production rate in the machine shop increased materially. Design of the forging is not mandatory, except where the Ordnance Department purchases forgings for delivery to Army arsenals or to machine shops not connected with the forge shop. The machine shop can arrange with the forger to supply forgings which vary from dimensional specifications, except in the finish-forged cavity, so long as the finished shell are acceptable.

There is no economy in penalizing any machining operation because of lack of foresight in making the forging, and it will speed the shell program considerably if forgings delivered to the machine shop are of accurate shape and have but little excess stock. In this connection, it should be pointed out that forgings should be made long enough on the nose, or open end to allow the parting tool used for cutting off excess stock to be in clean metal for the full length of its cut. Also, forgings should be cleaned carefully before delivery to the rough turning operation, either by pickling or shotblasting, as the roughing tools will wear rapidly if the scale is heavy. It is essential that close attention be paid to the quality and accuracy of the forged cavity, since it is cheaper to maintain a forging punch than it is to bore the cavity of a shell.

Development of the finished-forged-cavity shell has been of major importance in speeding the production of finished shell, even though it has complicated forge shop operations on the same shell. Benefits in the machine shop have more than offset the added tool cost in the forge shop. Modern high-explosive shell of practically all nations now have finish-forged cavities. While no boring or reaming operations now are considered necessary in the cavity of U. S. Army shell of the sizes being discussed, it is understood that in England, Germany, Italy, and France before the collapse, a reaming operation is employed to insure removal of any free metal left at the bottom of the cavity by the forging operation. This usually is done with a four-blade bottoming reamer set up in a heavy-duty drill press.

When machining shell, once the manufacturing line has been set up and is in operation, there are four principal factors to watch carefully if scrap is to be kept within reasonable limits. These are: (1) size, (2) weight, (3) center of gravity, and (4) capacity of cavity. Just as was the case during the last war, shell contractors will find that the exacting requirements and small tolerances common to shell specifications make it desirable to finish turn to the high limits, rather than run the danger of rejection because of lightness. This is especially true in the larger sizes of shell. A heavy shell nearly always can be brought down to weight, but a light shell usually must be scrapped. For U. S. shell, the weight tolerance shown in Table II is not equivalent to dimension tolerances, and dimensions must be controlled to bring the shell body within the weight tolerance.

Sequence of Operations on H.E. Shell

Because of the differences in machines and methods for shell production, there are a number of variations in possible sequence of operations, and in the number of operations done on any one machine. Developments in shell manufacture are still in the making, in fact the Ordnance Department is continuing experiments with materials and methods that may bring about important changes in the future. The following sequence of operations, discussed in a recent article (*AM*—Vol. 84, page 667), is used by the Frankford Arsenal to produce 3,000 shell of the 75-mm. size in an eight-hour day with only 41 machine operators. Many of the operations performed on this size of shell are similar to those used on larger and smaller sizes.

The Frankford Arsenal sequence is: (1) shotblast interior surfaces of forging to remove all scale; (2) center accurately to insure concentricity, as all succeeding operations are dependent upon it; (3) cut-off, rough turn and face base in automatic single-spindle machine; (4) cold nose in crank press; (5) finish turn exterior surfaces in a vertical two-slide machine; (6) drill and tap setscrew hole, using locating fixture on two-spindle sensitive drill press; (7) finish both ends and band seat, using an eight-spindle double indexing machine; (8) notch in hand-miller using indexing fixtures; (9) stamp with year of manufacture, size and style of projectile, and the initials of the manufacturer; (10) knurl band seat; (11) assemble and press rotating band into place; (12) rough and finish turn band, groove band and

trim to width; (13) spot or seam weld base cover in position on closed end of shell; (14) wash shell to remove all oil and grease so that paint will adhere without peeling; (15) final inspection, performed 100 per cent on all shell; (16) insert setscrew and grease threads; (17) paint exterior and interior surfaces; (18) place six shell in a carton for shipment to the loading depot.

It will be noted that the above sequence does not include heat-treatment of the shell, heating for the nosing operations with the subsequent shotblasting for cleaning, nor boring the cavity, all of which were choke points in shell production lines during the last war. Elimination of these operations through experiments conducted by the Ordnance Department have reduced the amount of equipment required and the time necessary for shell production in the 75- and 90-mm. sizes. The larger sizes still require heating for nosing, and so must be shotblasted afterward to remove scale.

Among the other operation line-ups being used for making shell in this country is that developed by W. C. Lipe, Inc., in connection with the use of machines of their manufacture for shell operations. Two possible floor plans for arrangement of equipment necessary for the following operation are shown in Figs. 3 and 4. The sequence is: (1) load shell on conveyor dollies, center closed end and face open end of shell forging; (2) rough turn outside of shell forging; (3) semi-finish turn and face closed end, during machine cycle operator will do operation 4; (4) cold nose to form ogive in crank press; (5) bore, face and chamfer open end; (6) finish turn shell body; (7) cut band groove and remove center boss; (8) grind base of shell with disk grinder, operator loads work in test fixture for operation 9, then grinds base of shell on piece previously tested; (9) pressure test for leaks, seams and porosity; (10) stamp identifying data on body, one operator will do operations 10, 11, 12 and 13; (11) notch nose in hand miller; (12) knurl band groove; (13) drill and tap for setscrew at open end of shell; (14) thread nose in thread miller, same operator does operation 15; (15) wash shell to remove all oil, grease and dirt; (16) assemble and press on band, combine operation 17 and 18 with this operation; (17) finish turn band; (18) weld base cover plate; (19) weigh and (20) final inspection, one operator for both; (21) government inspection; (22) apply masking tape and paint inside of shell, two operators perform this and all following operations; (23) paint outside of shell; (24) assemble closing plug and setscrew, remove masking tape, and clean empty conveyor dollies.

In making any set-up for shell machining, the companion problems of material handling and chip disposal must be given careful consideration. Usually floor space will be too valuable to permit using it for storage of partially finished shell between the machines. During the last war a number of American and Canadian manufacturers of shell solved the material-handling problem by making special trucks, like that shown in Fig. 5. The detachable top shelves with which this truck was provided served as inter-machine inspection tables. Wooden pins were so spaced that shell which had been nosed-in or "bottled" might be laid between them while shell not already nosed-in were placed over the pins.

Such methods of handling shell are, however, entirely too slow for consideration during the present shell production program. Full advantage must be taken of lessons learned about low-cost, high-speed material transportation in the automotive and other mass-production industries during recent years. Various arrangements of standard and special roller conveyors, over-head chain conveyors and other types are possible. Consideration as to the means to be used should be made before the production line-up finally is made, as it usually is more economic to develop the machining and material-handling set-up as a unit, rather than to place the production equipment in position and then try to fit some material-handling scheme to the layout. Some of the machines developed for various operations on shell have incor-

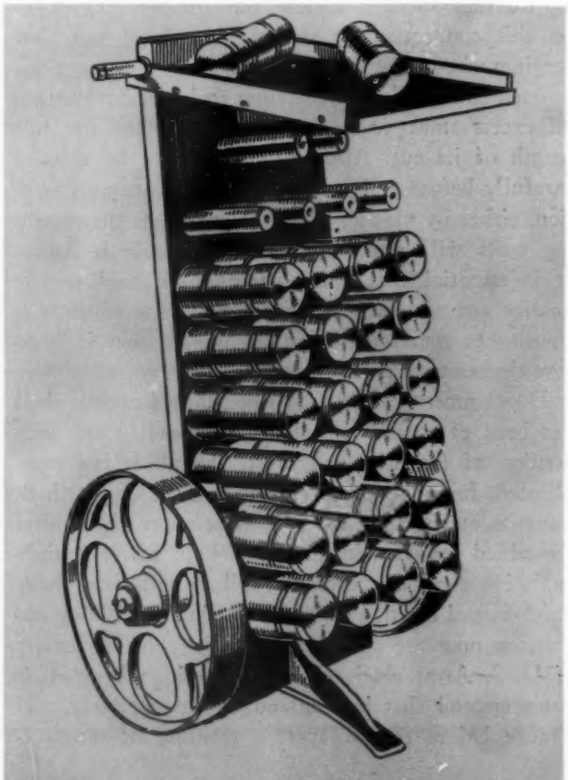


Fig. 5—Trucks of various types were used in shell plants during the last war for moving shell from one operation to the next. This pin-type design had a detachable shelf for interoperation inspections

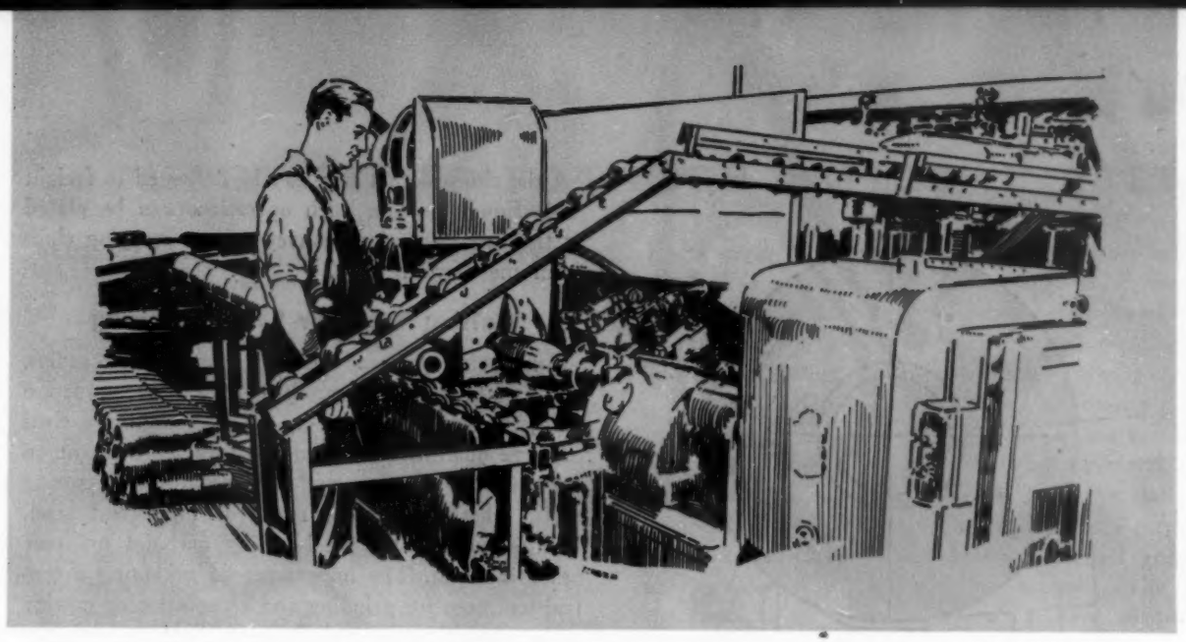


Fig. 6—A number of interesting conveyor arrangements have been installed in the shell shop at Frankford Arsenal. This one serves a nose turning lathe

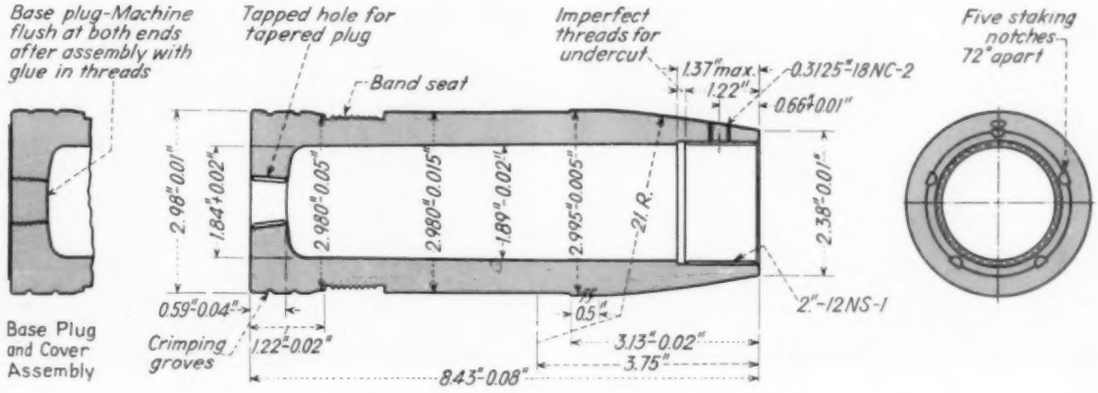
porated in their tooling arrangement various means of handling the shell into and out of the machine.

In Fig. 6 is sketched a special roller conveyor installation placed over and around a shell turning lathe at Frankford Arsenal. Rollers used in this conveyor line are larger in diameter at the ends than in the center, so that the round shell, which travels endwise along the conveyor, is prevented from rolling off onto the floor. In the set-up shown, shell are delivered to the machine along the horizontal line in front of the operator, while finished shell are pushed up the inclined line across the machine into the elevated conveyor line which delivers the shell to the next machine.

Fig. 7 shows a type of conveyor roll that has been used in Europe. The rolls are centered on both ends and held in position between the conveyor rail by pointed setscrews. Normally the rolls have a tapered section on both ends, but at positions where the shell are to be transferred from one conveyor line to another the rolls are turned off straight on one end, as shown. Cast iron rolls are used for all roughing operations, but are replaced with hardwood or rubber rolls having steel inserts in conveyor sections following the finish turning operation. An improvement of this design incorporates ball bearings at each end of the rolls, in place of the pointed setscrews.

Some of the larger European shell plants have been using sheet metal troughs with a drag chain in the bottom to transfer shell from one machine to the next, or from the machine line to the finishing, inspection and boxing stations. Small shell sometimes are put in boxes or tote pans and passed from operation to operation or roller conveyor lines. In one French plant bridges constructed over roller conveyor lines stretching through the plant were used for foremen's desks as well as for passageways across the plant.

Where shell are being made in any quantity, the problem of chip disposal is as important as the problem of transferring shell from one operation to the next. Not only must the machines be arranged so that chips easily can be removed to trucks or conveyor lines, but arrangements for transportation of the chips through the plant must be provided. Here our experience with under-floor chip conveyor lines in some American plants will be of value. It probably will be necessary to provide for extraction of cutting oils from the chips, as well as breaking up or crush-



The 3-in., M42B1, high-explosive anti-aircraft shell body is made from WD-1035 seamless steel tubing. Hole in the base is closed with a taper-threaded plug, which is pulled up tight before glue put on threads can set

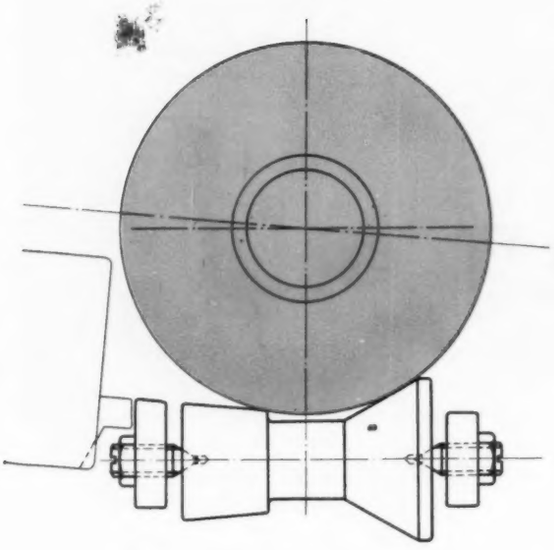


Fig. 7—This type of cast-iron conveyor roll has been used in European plants for moving shell from one operation to the next. Normally the rolls have a tapered section at each end, but rolls at transfer points are turned at one end as shown so shell easily can be rolled across to another line

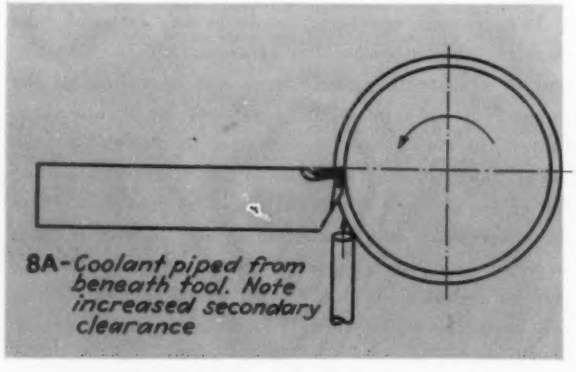
ing the chips so that they can be delivered to freight cars. Equipment for such operations can be placed at the delivery end of conveyor lines carrying chips from the machine shop.

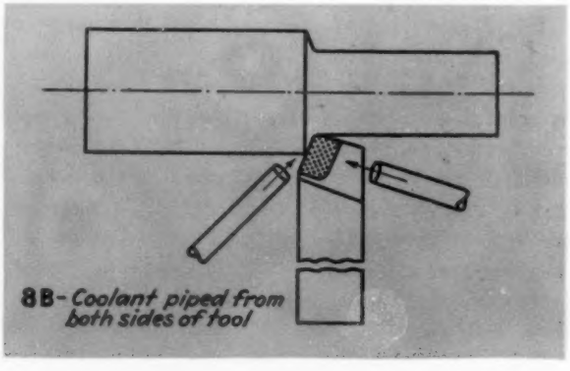
Cutting Tools for Shell Machining

Just as in the production of automobiles, radios, refrigerators and other products on a mass-production basis, the success of a set-up for manufacturing shell in large quantities is dependent to a large extent on the careful selection and maintenance of cutting tools, whether they be made of high-speed steel, Stellite, one of the steel-cutting carbides or some other material. The importance of providing a central toolroom for grinding and reconditioning cutting tools cannot be over-emphasized. Such a toolroom should be supervised by a man who not only is familiar with machine shop practice, but who has had considerable experience with small tools. This recommendation holds true no matter what type of production equipment is installed for machining shell, as tool maintenance problems exist with either simple, single-operation machines, or with high-production, multi-tool units.

It also is recommended that several complete sets

Fig. 8—Effective cooling of the cutting tool depends upon volume of coolant supplied, velocity of coolant stream, and direction of coolant application in relation to the chip. A, B and C show three methods for obtaining more efficient cooling of a tool





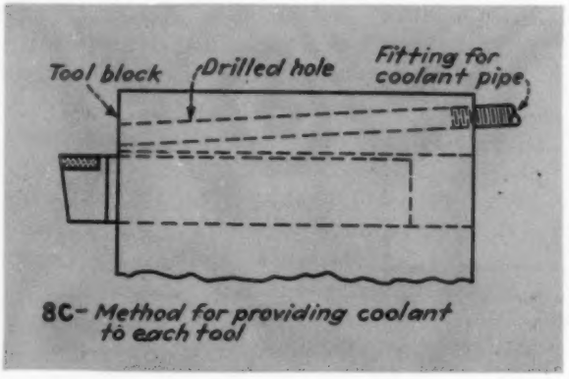
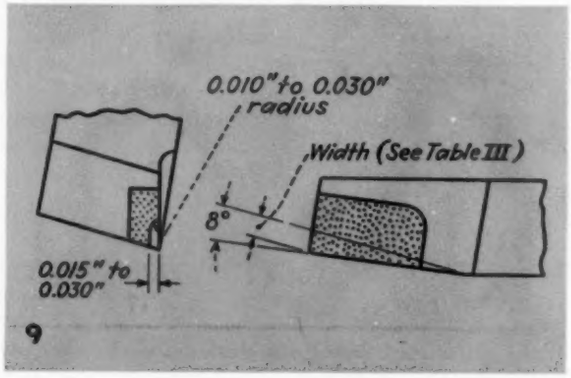


Fig. 9—A ground-in, step-type chip breaker of this type is satisfactory for most steel turning operations with single-point, carbide-tipped tools. For cuts under 1/32 in. deep a small 1/16 in. wide step ground at 45 deg. with the cutting edge used



of cutting tools be provided for each machine set-up. The operator should have at hand at least one set of ground tools ready for installation in the toolholders should the set in use become dull or broken. And there should be two or three more sets either in the toolroom being sharpened or enroute between the machine and the toolroom. In no case should the operator be required to go to the toolroom for a set of tools. These should be brought to him, and the dull tools taken away by some inexperienced helper. The operator, whose skill is of prime importance in the proper use of machining equipment, is far too valuable a man in the present emergency to make it necessary for him to spend any portion of his time doing work that can be performed by an unskilled, untrained worker.

No matter what material is used for the cutting tools, the use of magazine tool holders (standard blocks into which single-point tools can be set and ground in the toolroom) is to be recommended, as their use permits the workman to change a tool in his machine in a matter of seconds. Otherwise, each tool change in the machine involves setting the tool to height and diameter in relation to other tools in the set-up, and usually involves taking one or more trial cuts. Although permissible under ordinary conditions, such excessive set-up time cannot be justified in the production of shell. The magazine or standard tool holder blocks should be equipped with shims or tapered wedges for setting the tool in the holder at a standard height and extension, so that the unit can be placed in the machine against stops, clamped, and thus be positioned within 0.001 in.

One of the lessons learned in England on shell turning is the desirability of using larger tools with larger carbide tips than is current practice for most steel turning operations. The increased mass of the tool absorbs vibration and heat more effectively, thus leading to longer tool life and less machine down time. Where we would use a tool shank measuring 1 × 1 in. in this country, in England they are using shanks 1¾ in. wide and 2 in. deep on similar work. Also, the hand honing of cutting edges has been found desirable in England on both high-speed steel and carbide cutting tools employed for turning shell.

It has been found desirable to use as small a nose radius as possible on the cutting tool when turning steel shell bodies, no matter what the material from which the tool is made. Where several tools are mounted together in a set-up so that they are cutting at the same time, the use of different lead angles on the tools often stops vibration brought about by the heavy load on the machine. Factors affecting design of single-point tools for shell machining operations are but little different from those governing the design of tools used for machining other parts made from similar steels. The fundamental requirement is that the tool must be free-cutting, and at the same time possess adequate strength.

The use of coolants increases the tool life on all steel-cutting jobs. Soluble oil is generally superior to other coolants. To assure effective cooling of the tool, the coolant, pump, tank and piping should be of large capacity to assure ample volume of coolant, the coolant should leave the nozzle under sufficient pressure to force it against the tool and the work, and it should be directed so that the obstruction caused by the rapidly-forming chip does not interfere with the flow. It is frequently possible to obtain more efficient cooling of the tool by using one of the methods shown in Fig. 8. In many applications, the delivery of a large volume of coolant is not sufficient; velocity of flow often has been found to be a deciding factor. Frequently, an increase in pressure under which the coolant is delivered to the work has materially improved cutting conditions.

The high tensile strength of steel results in the production of a continuous chip when machining is done at the high speeds ordinarily employed with carbide tools. In order to make it safe for the operator to work around the machine, and to permit easy chip disposal, it is necessary that this continuous chip be broken into relatively short lengths. The ease with which the chip may be broken depends upon the cross-section of the chip and the physical characteristics of the steel being cut. Breaking characteristics frequently can be improved by rapid cooling with a heavy flow of coolant and increasing the feed to obtain a cross-section which breaks readily. Three successful means of chip control are: (1) the use of a ground-in chip breaker to stress the chip to the breaking point; (2) the use of a combination of tool angles and nose radius to obtain a coiled chip which can be directed into the work or against some obstacle which will stress the chip and break it; and

Table III—RECOMMENDED WIDTH OF STEP-TYPE CHIP BREAKER

Feed In. per Rev.	*Depth of Cut* 1/64 *to* 3/64 *in.*	*Depth of Cut* 1/16 *to* 1/4 *in.*	*Depth of Cut* 5/16 *to* 1/2 *in.*	*Depth of Cut* 9/16 *to* 3/4 *in.*
0.008 to 0.012	1/16	3/32	1/8	5/32
0.013 to 0.017	5/64	1/8	5/32	3/16
0.018 to 0.022	3/32	5/32	3/16	7/32
0.023 to 0.027	7/64	11/64	13/64	15/64
0.028 to 0.032	1/8	3/16	7/32	1/4

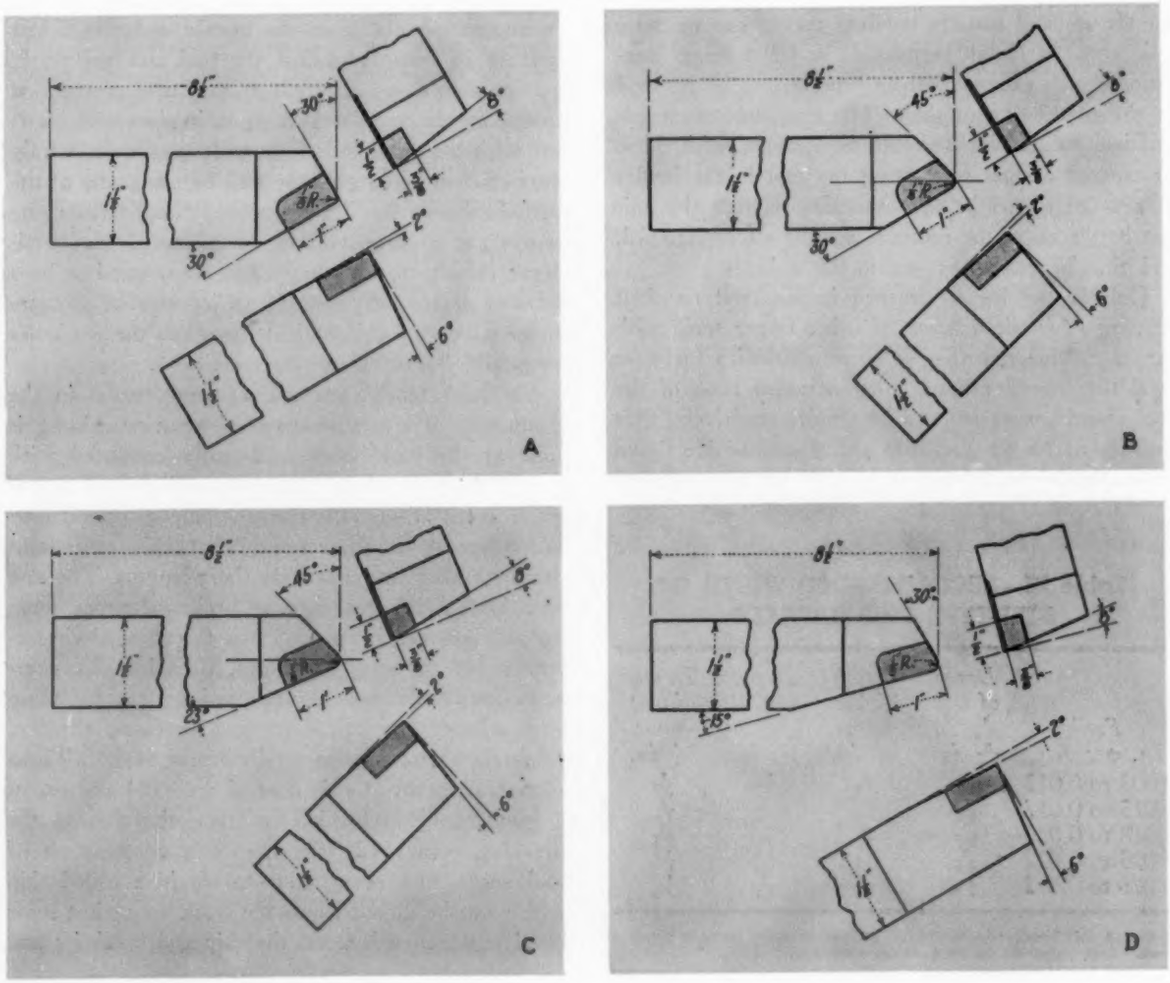
Note: A chip breaker depth of 0.020 in. is satisfactory for most types of steel. *Data furnished by the Carboloy Company.*

(3) the use of a mechanical chip breaker mounted on top of the tool just just back of the cutting edge. Of these three methods, the first is the most widely used. In Table III are given recommended widths of step-type chip breakers for various feeds and depths of cut when using carbide tools. Satisfactory design for such a chip breaker is shown in Fig. 9.

Recommended speeds and feeds for turning free-cutting SAE X1314 to X1340 steels with Carboloy tools are shown in Table IV. The values given are for average work and quantity production when sufficient power is transmitted to the spindle to prevent stalling. Speed can be adjusted up or down, as advisable, within the range indicated. The Carboloy grade shown in column *A* is, in each case, one having a wide margin of safety for average shop work. The purpose of listing the grades shown in column *B* is to provide an additional selection when it is desirable to make specific improvements in tool performance to meet quantity production conditions. Suggested tool angles are: Front and side relief, 6 to 12 deg. (start at 7 deg.); back rake, 0 to 10 deg. (start at 0 deg.); side rake, 4 to 12 deg. (start at 8 deg.).

It is important that sufficient power be provided before attempting to use carbide tools. In the event of the machine stalling for any reason, do not attempt to move the work or try to back the tool out of the cut. It is best to loosen the holding screws and remove the tool from the cut, as this may prevent breakage of the tip. At the higher speeds used with carbide tools, it is necessary that space be provided for the increased volume of chips produced. This is especially important on multiple-tool set-ups, as the additional chip-handling problem at higher speeds sometimes will more than offset the time saved on a machining operation. Often sheet metal chutes can

Fig. 10—These four Kennametal-tipped steel-cutting tools have been designed especially for rough turning forged steel shell bodies in multiple-tool set-ups. They are grouped in various combinations



be used to advantage for directing the flow of chips.

High-speed steels, Stellite, and a number of the various grades of tungsten-tantalum, tungsten-titanium and tungsten-tantalum-titanium carbides have been used successfully in tooling for shell operations. A number of contractors prefer to use high-speed steel tools on roughing operations where there is considerable scale, which will cause rapid wear of the more expensive cemented carbides, while others remove scale by shotblasting and use carbide-tipped tools throughout the line. Most of the suppliers of the cemented carbides have had considerable experience in tooling for shell work, including Carboloy, McKenna Metals, Vascoloy-Ramet and Firth-Sterling. A little more than a year ago the controller of machine tools for the Ministry of Supply in England stated that shell now are produced in minutes, as compared with hours at the end of the last war, because of the application of carbide-tipped tools. In 1918 the hardest available cutting tool could retain its edge only for about 50 medium caliber shell. Today, with carbide-tipped tools, some 400 to 500 shell can be machined before regrinding the tools.

Generally, steel-cutting carbide tools will remove more metal per minute with less strain on the machine and tool than the slower cutting high-speed steel tools requiring heavy feeds to do the same work. However, the advantages of high speed cutting possible with carbide-tipped tools may be offset by chip disposal problems if proper chip control is not employed. Also attention should be given to relations between tool shapes when using a multiple-tool set-up for heavy cuts. In Fig. 10 are shown four carbide-tipped tools recommended by McKenna Metals Company for rough turning forged steel shell bodies. Used in groups of three or four, these tools have side cutting edge angles of 15 to 30 deg. This adds greatly to tool life, as compared with tools having cutting edges at right angles to the axis of the work. End cutting edge angles are made relatively large so as to clear when plunging into the work for the divided cut. Various combinations of these tools are used in rough turning shell; for instance, in one set-up tools *B, C* and *D* are recommended, in another *A* and *D* are placed side-by-side for rough turning a a shorter shell. For a 155-mm. shell the tool sequence on the turning carriage was *A-D-D-D-D-C*, reading from the nose end. Groove-type chip breakers must be ground in these Kennametal tools, as the work is cut at about 300 ft. per min. A parting tool and a base facing tool, each tipped with Grade KM Kennametal, for shell roughing are shown in Fig. 11. The $\frac{1}{2}$-in. width of the parting tool is sufficient to prevent weaving. Both of these tools are ground with a shelf-type chip breaker parallel to the end cutting edge. The shelf is about $\frac{1}{32}$ in. deep and extends about $\frac{3}{16}$ in. back of the edge.

Recognizing that there can be almost unlimited variations both in methods used for individual operations and in operation sequence, and that it is possible to use a number of machines for subdivided operations, thereby increasing floor space requirements

Fig. 11—From 150 to 200 shell forgings of the 75-mm. size are cut off per tool grind with the Kennametal-tipped parting tool shown at A. The tipped facing tool at B has a longer life

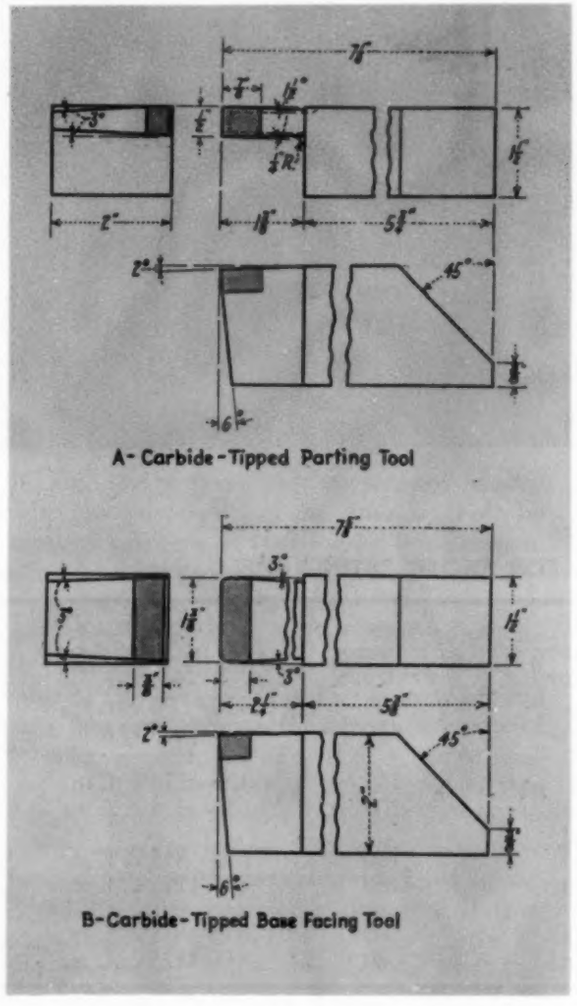


Table IV—SPEEDS AND FEEDS FOR SHELL STEELS

Depth of Cut Inch	*Max. Feed Inch*	*Starting Speed R.P.M.*	*Speed Range R.P.M.*	*Carboloy Grade A*	*B*
$\frac{1}{64}$ to $\frac{1}{32}$	0.010	350	250–500	78	831A
$\frac{3}{64}$ to $\frac{3}{32}$	0.020	275	200–350	78	831A
$\frac{1}{8}$ to $\frac{7}{32}$	$\frac{1}{32}$	275	150–350	78B	78
$\frac{1}{4}$ to $\frac{1}{2}$	$\frac{1}{32}$	275	150–350	78A	78B

Data furnished by the Carboloy Company.

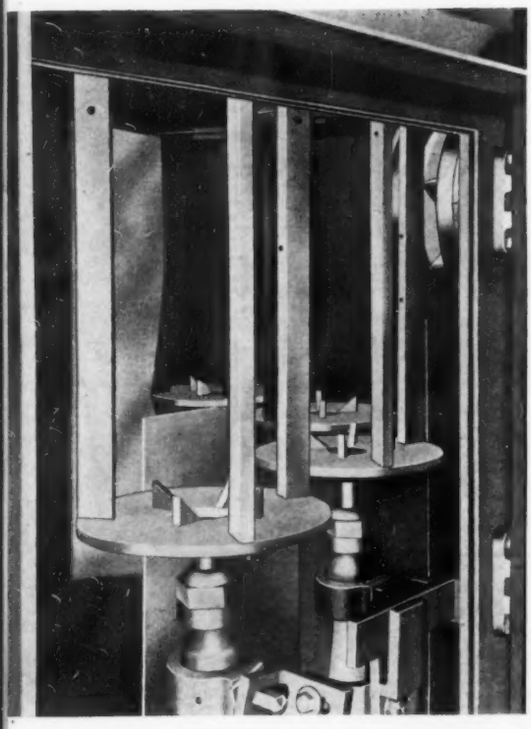


Fig. 12—Simple hangers support shell forgings with the open end down in the shotblasting machine developed by The American Foundry Equipment Company. Vertical air-blast nozzles, of which two are shown, clean the cavity of the forging, while the Wheelabrator unit in the side wall cleans exterior surfaces of the shell

Fig. 13—Easily operated by one man, this loading and unloading device handles shell forgings in and out of the American Foundry Equipment Company's shell shotblasting machine. It can be served by a roller conveyor line if production requirements justify

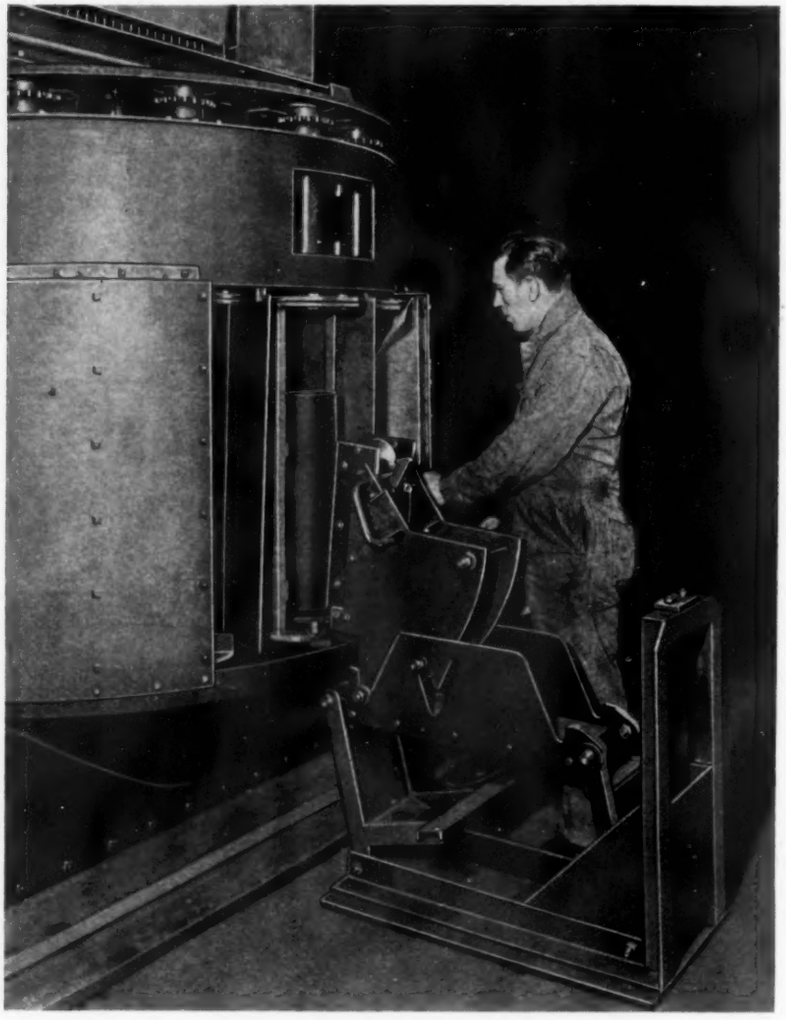


Table V—PRODUCTION RATES FOR SHOTBLASTING SHELL

Size of Shell	*Number of Nozzles at 90 lb. Pressure*	*Estimated Production Per Hour*	*Air Required ($\frac{1}{16}$ in. nozzle wear allowed)*
75 or 90 mm	Two—$\frac{3}{8}$ in.	180	420– 570 c. f. m.
	Three—$\frac{3}{8}$ in.	250	630– 855 c. f. m.
105 mm	Two—$\frac{3}{8}$ in.	135	420– 570 c. f. m.
	Three—$\frac{3}{8}$ in.	200	630– 855 c. f. m.
5-in. A.A.	Three—$\frac{3}{8}$ in.	100	630– 855 c. f. m.
	Three—$\frac{7}{16}$ in.	150	855–1125 c. f. m.
155 mm	Three—$\frac{3}{8}$ in.	60	630– 855 c. f. m.
	Three—$\frac{7}{16}$ in.	80	855–1125 c. f. m.

Data Furnished by The American Foundry Equipment Company.

and the difficulties involved in training and supervising a larger shop force, or to group some operations for multiple-tool set-ups, the following discussion covers a number of different ways in which shell can be and are being machined. Each operation is taken up separately, and the sequence in which the operations are considered should not necessarily be taken as recommended practice.

Scale Removed by Shotblasting

Scale and other foreign material must be removed from the cavity of the shell forging before machining can be started, since the shell is located from the finish-forged cavity for the centering operation. Where carbide tipped tools are to be used for rough turning operations it probably will be found best to shotblast the outside surfaces also, as scale there will cause rapid wear of the cutting edges.

Government specifications require cleaning of the interior surface only, which must be done with air blast nozzles due to the small opening in the end of the shell. In machines made by the American Foundry Equipment Company for shotblasting shell forgings the exterior surfaces also can be cleaned without lengthening the production cycle by mounting a Wheelabrator unit on the side wall. Shell are placed in these machines with the open end down, so that the rebounding abrasive escapes quickly and does not act as a damper on newly discharged abrasive. Also, the shell is rotated while being blasted, so a nozzle aimed at the side wall cleans all the way around the interior circumference. The shell are successively indexed over two or three nozzles aimed at different points on the interior of the shell so that all of the interior surface is struck by abrasive on the initial discharge from the nozzles. Table V shows production rates to be expected.

In Fig. 12 are shown the hangers used in shell blasting machines made by the American Foundry Equipment Company. Two nozzles are shown in position in their clamps, and a Wheelabrator unit for cleaning exterior surfaces is seen at the upper right. Where heavy shell, 105-mm. and larger, are to be cleaned, a loading and unloading device is furnished. This loader, seen in Fig. 13 in its elevated position, has coned rollers and easily can be connected to a roller-conveyor line. The shell is placed horizontally in the loader, resting on three rollers, then the loader is raised on foot lever and the shell is placed in an empty hanger. The loader is returned to the horizontal position between loading and unloading, and also after removing a cleaned shell from the machine.

For the removal of forging scale, No. 18 Galion (18 mesh screen, 0.0406 in. opening) grit is used. For reclaiming shell prior to reloading, No. 60 (52 mesh screen, 0.0137 in. opening) grit is suitable. Abrasive breakdown is approximately 5 lb. per hour for each nozzle used under recommended pressures.

When shell forgings are nosed hot, or are heat-treated, it usually is necessary again to remove scale by shotblasting before continuing with machining operations. If grease has been used on the nosing dies, and the shell are not heat-treated after nosing, a gummy deposit that is difficult to remove by shotblasting often is left in the nose of the shell. This deposit should be removed by wire-brushing or washing with a suitable cleaning medium, then the shell can be efficiently cleaned by shotblasting.

The Pangborn Company also makes equipment for automatically shotblasting both inside and outside surfaces of shell forgings. Like the machines described above, this equipment is suitable both for cleaning prior to the first rough machining operations, and for cleaning after nosing and heat-treating.

Set-Ups for Centering Are Varied

Ordnance Department drawings for shell call attention to the fact that the shell must be carefully centered during the various machining operations in order to maintain concentricity of the various cylindrical surfaces. Final accuracy of the machined shell therefore must depend to a large degree upon the accuracy of the first centering operation, as it is from this center that later operations are located. Practice at Frankford Arsenal is to test centering arbors daily with an accurately finished master shell, using a dial indicator to check the concentricity of the outside surfaces while the master is centered on the arbor and the spindle is rotated.

In the finished shell, the following maximum eccentricities are acceptable: (1) between fuze or adapter seat threads and outside cylindrical surface, 0.015 in. for shell from 75- to 155-mm., inclusive; (2) between bourrelet and rotating band, with shell body, 0.006 in. for 75- and 90-mm. shell, 0.007 in. for 105-mm. shell, and 0.008 in. for 155-mm. shell—bourrelet must overlap shell body on entire circumference; and (3) between cavity of shell and outside cylindrical surface, 0.015 in. for shell from 75- to 155-mm. inclusive. When measuring eccentricity with a dial indicator, the total reading of the dial is twice the actual eccentricity. A simple gage used at Frankford Arsenal after rough and finish turning for determining variations in wall thickness was described in a recent article (*AM*—Vol. 84, page 667).

There are a number of satisfactory methods by which the shell forging can be cut to length and centered. First, the forging may be both centered and cut off in one operation, as in the set-ups de-

scribed below; (2) the forging may be gaged and cut to length by one of several methods and then centered on a second machine; or (3) the forging may be centered and then the cut-to-length operation combined with the rough turning operation, as in the Jones & Lamson and other set-ups to be described later. Where forgings are uniform, and extra length does not interfere with the work-holding fixture, the combining of the cut-off operation with either centering or rough turning is less expensive than doing each operation separately.

In some cases the boss raised at the center of the closed end of the shell for the center either is not square or smooth enough to permit the center drill to start accurately. Hence an extra operation to smooth the face of this boss may be required. This can be done by grinding or milling. Where carbide-tipped tools are to be used for the rough turning operation, it is recommended that a center of at least $\frac{3}{4}$ in. diameter be used. With smaller centers, chatter and broken tailstock centers can be expected.

Gisholt recommends the use of a No. 12 hydraulic automatic lathe for a combined centering and cut-off operation on 75-, 90- and 105-mm. shell. Their Simplimatic lathe is offered for the same operation on 155-mm. shell. Tooling and work-holding fixture are virtually the same in both cases, as is indicated in Fig. 14, except that both are considerably heavier for the larger shell.

Differing only in size, the set-ups on the No. 12 lathe, outlined at *A* in Fig. 14, incorporate an air-operated expanding fixture having six jaws which hold the shell in the powder cavity, locating for depth against the bottom of the cavity as shown. The two carbide-tipped parting tools are mounted on the rear slide and on an auxiliary front slide mechanically interlocked with the rear slide. For centering, a motor-driven drilling attachment is mounted on a second rear slide. Spindle speed is selected to maintain about 250 ft. per min. cutting speed for the parting tools, a feed of 0.006 in. per rev. being used. Slides feed against and dwell at positive stops.

The Simplimatic lathe used for cut-off and centering operations on 155-mm. shell employs a tooling set-up similar to that shown at *B* in Fig. 14. It will be noted that the fixture in this case, while similar in operation, is considerably heavier than that employed for smaller shell. The six-point expanding fixture is operated by a 12-in. air cylinder, and carbide-tipped parting tools are used in the front and rear tool blocks. Estimated floor-to-floor times range from 0.8 min. for 75-mm. shell to 2.0 min. for the 155-mm. size.

Operation of work-holding arbors for the above

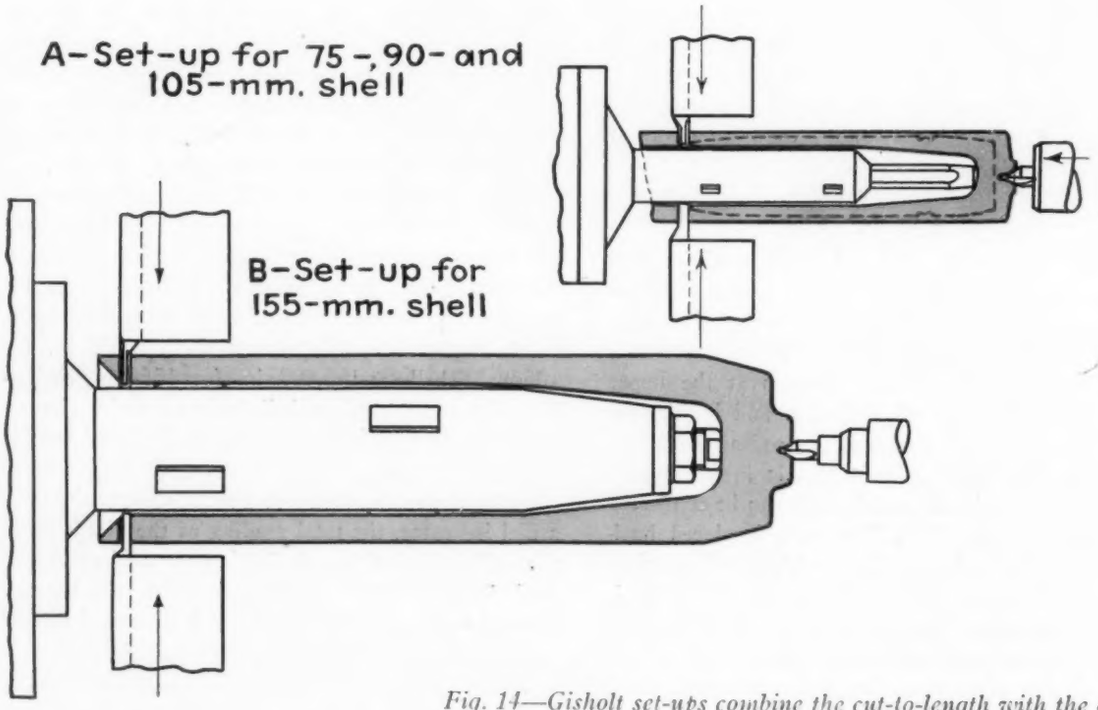


Fig. 14—Gisholt set-ups combine the cut-to-length with the centering operation. Shell of 75- to 105-mm. size are set up in a No. 12 hydraulic automatic lathe, while the larger 155-mm. shell are cut off and centered in a Simplimatic lathe

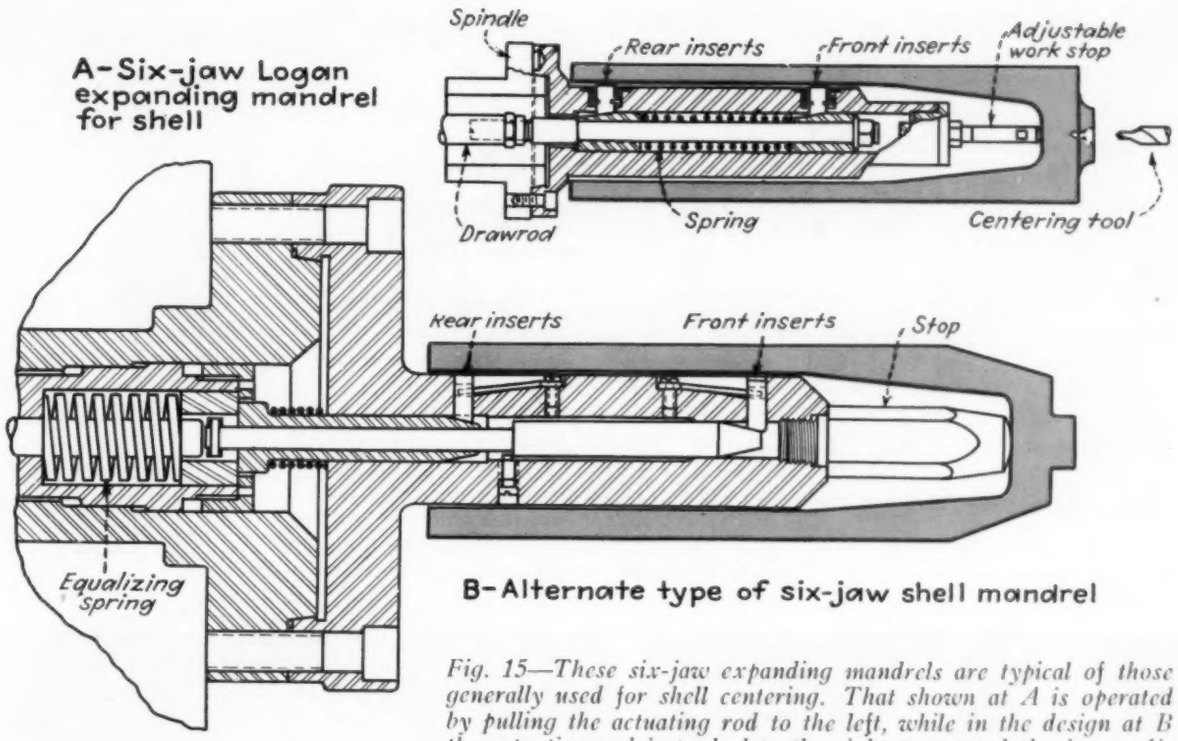


Fig. 15—These six-jaw expanding mandrels are typical of those generally used for shell centering. That shown at A is operated by pulling the actuating rod to the left, while in the design at B the actuating rod is pushed to the right to expand the jaws. Air or hydraulic cylinders may be used

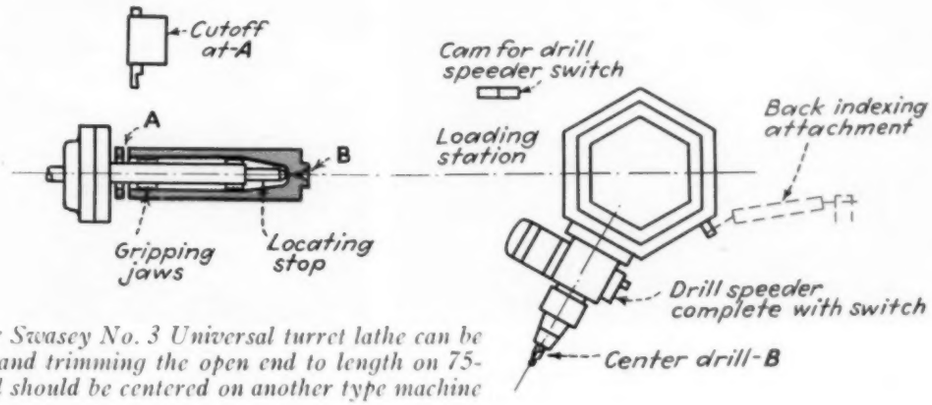


Fig. 16—A Warner & Swasey No. 3 Universal turret lathe can be adapted for centering and trimming the open end to length on 75-mm. shell. Larger shell should be centered on another type machine

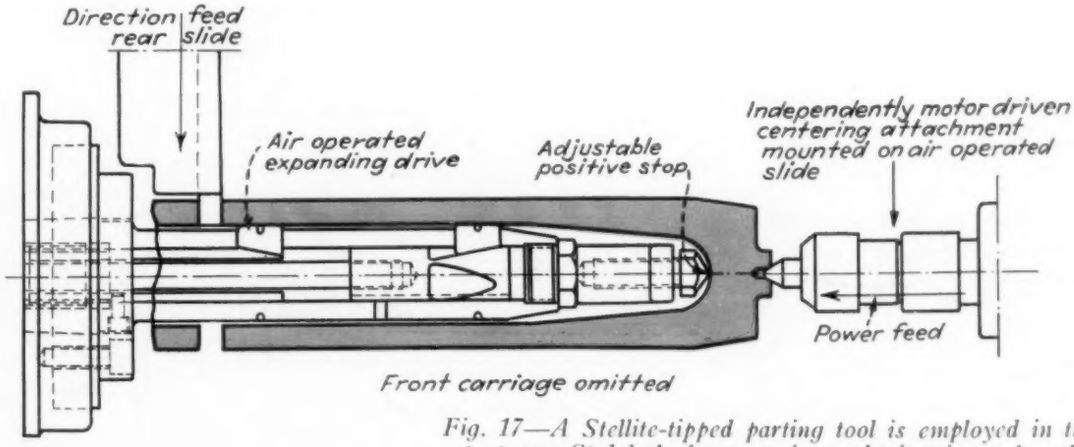

Direction feed rear slide
Air operated expanding drive
Adjustable positive stop
Independently motor driven centering attachment mounted on air operated slide
Power feed
Front carriage omitted

Fig. 17—A Stellite-tipped parting tool is employed in the above set-up on a Stub lathe for centering and trimming to length 75-mm. shell forgings. Production with this layout is 62 pieces per hour

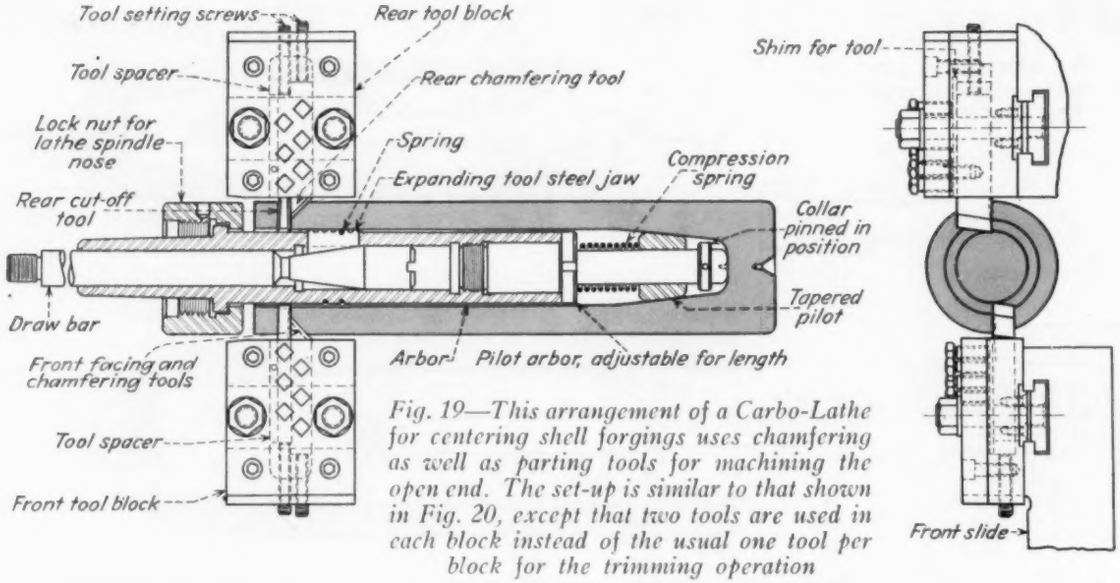


Fig. 19—This arrangement of a Carbo-Lathe for centering shell forgings uses chamfering as well as parting tools for machining the open end. The set-up is similar to that shown in Fig. 20, except that two tools are used in each block instead of the usual one tool per block for the trimming operation

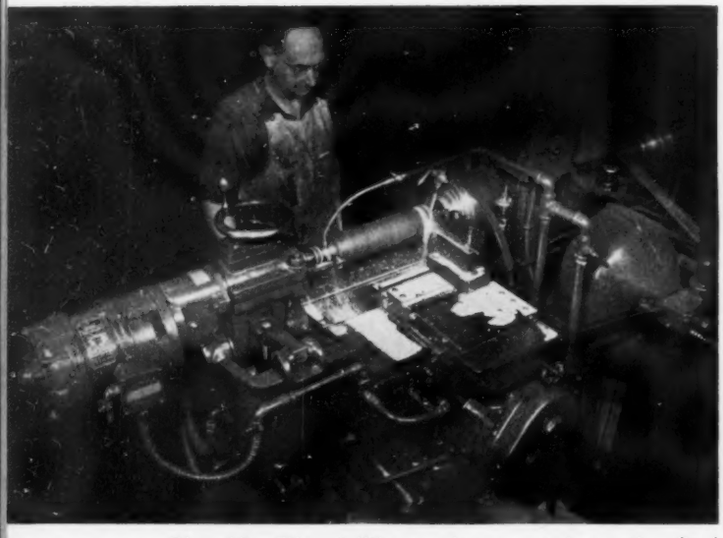


Fig. 18—The drilling unit mounted on the Stub lathe for the centering operation is swung aside with an air-operated toggle mechanism when not in use. This provides clearance for loading and unloading forgings on the spindle fixture

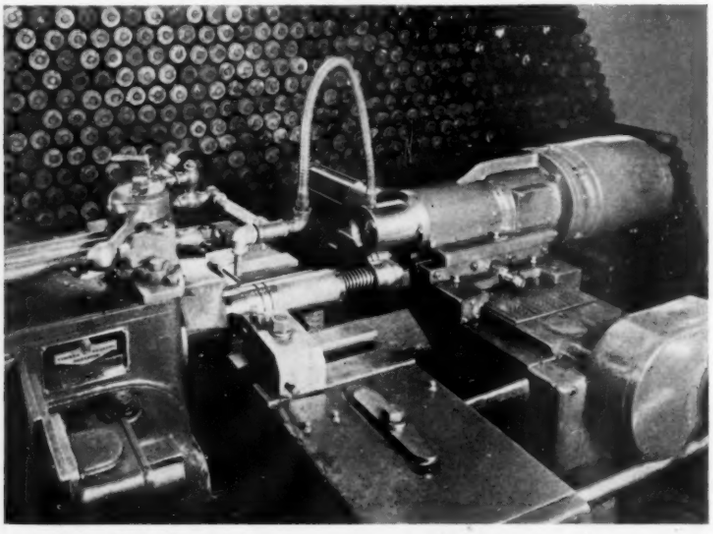
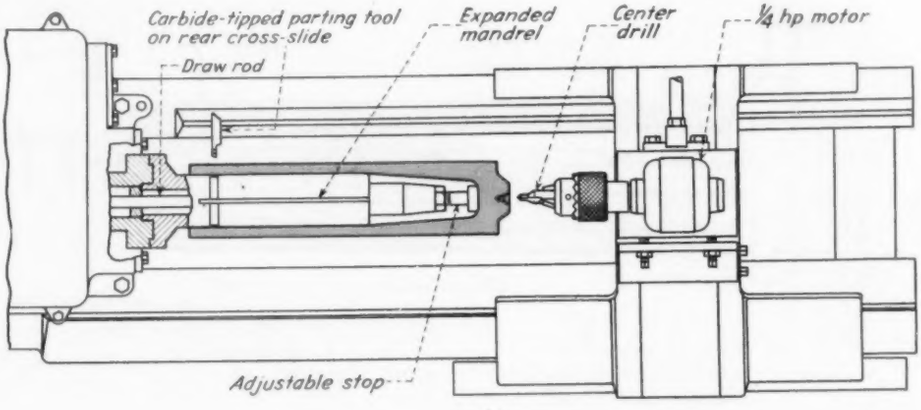


Fig. 20—The Lipe arrangement for moving the drill unit to the rear of the bed while loading or unloading uses an air cylinder. A positive stop is used to reposition the drill in line with the spindle of the lathe

Fig. 21—Operator only has to load and unload the Sparks-Simplex No. 101-A hydraulic centering lathe. Parting tool and centering drill in this set-up go through an automatic cycle once the spindle is rotating and a pilot valve has been shifted



and other centering operations is quite similar. In Fig. 15 are shown two six-jaw expanding mandrels developed especially for shell operations. Made by Logansport Machine, Inc., the mandrel shown at *A* has six jaw inserts which are expanded when the drawrod is moved to the left, the front set of three jaws being positively actuated while the rear set are actuated by compression on an equalizing spring. This compensates for any variations in diameters of the cavity, and insures equal gripping pressure to the two positions. The fixture shown at *B* in Fig. 15 is similar in principle, but in this case the jaws are expanded by pushing the rod toward the right. In both fixtures the work stop is adjustable.

Fig. 16 shows a set-up on a No. 3 Warner & Swasey geared head turret lathe for centering and trimming to length 75-mm. shell forgings. Here, high-speed steel is used for the parting tool as well as for the center drill, the work being rotated at 110 r.p.m. Parting tool feed is 0.0065 in. per rev. The forging is chucked on an air-operated expanding arbor, similar to those shown in Fig. 15, the stop on the end of the arbor establishing the depth of the cavity for the parting tool. For center drilling in this set-up, a motor-driven drill speeder is mounted on the hexagon turret and is connected so that it shuts off automatically when indexed off the drilling station. Center drill speed is 425 r.p.m. Power feed is furnished for the cross-slide with the parting tool, while the center drill is fed by hand. A back indexing attachment can be mounted on the hexagon turret to return the turret to the loading position without effort on the part of the operator.

Center drilling and cutting off the open end of the 75-mm. shell forging also are combined in the set-up in Fig. 17 developed for the Sundstrand "Stub" lathe. Location is from the inside of the closed end, so that the cut-off end of the shell is held in accurate relation to the forged cavity and this surface can be used for locating purposes in operations which follow. Driver is of the six-pin, air-operated expanding type. The three pins at the outer end of the driver centralize the part and the three other pins, in addition to centering, do the driving. A single cross-feeding tool slide carrying a Stellite tool is attached to the rear of the bed of the 8-in. lathe.

The independently motor driven centering attachment is mounted on the end of the machine bed. It has power feed for an automatic drilling cycle. The amount of rough stock on the center boss varies considerably, so a gage is provided to locate the depth of center in relation to the end of the boss. When the centering attachment is swung into position after the part has been loaded, the operator quickly can check the relation of the gage to the end of the boss and move the centering spindle into proper position with a handwheel. Operating data: Work speed, 120 ft. per min.; parting tool feed, 0.015 in. per rev.; floor-to-floor time, 0.82 min.; hourly production at 85 per cent efficiency, 62 pieces. Fig. 18 shows a Stub lathe performing this operation and gives details of the air-operated toggle mechanism with which the drill unit is moved aside when not in use.

In a recent application of a Lipe "Carbo-Lathe" for the center and trim-to-length operation on 75-mm. shell, chamfering tools were mounted in the front and rear tool blocks as shown in Fig. 19. A somewhat different work-holding arbor assembly has been developed by this company for this and similar operations. Here, only one set of three expanding jaws is used, centering in the bottom of the cavity being accomplished by using a tapered pilot held against the walls of the cavity by spring pressure. In this set-up the rear tool block advances a little ahead of the front block, thus providing clearance for the finishing tools on the front block. Work speed is about 300 r.p.m., center drill speed is 900 r.p.m., tool feed is 0.010 in. per rev. and the center drill is fed by hand. Tantalum-carbide tipped tools are used.

A similar set-up for 75-mm. shell is shown in Fig. 20. Here tantalum-carbide rough and finish facing tools are used, instead of parting tools. In these Carbo-Lathe set-ups the sequence of operation is: Operator loads work on the arbor, then closes a switch to start the spindle, the tools then automatically rapidly approach work, take feed cut and return to the loading position. At the end of the cycle the machine stops automatically, ready for unloading. While the machine is making this automatic cycle, the operator positions the drill and centers the work to a positive stop, thus making every center to the same distance from the bottom of the cavity. As the centering device is returned to the loading position it automatically recedes to the rear of the bed, thus providing room for handling work on and off the arbor. Estimated production time for 75-mm. shell, using the set-up shown in Fig. 20, is 50 sec. per piece. A similar tooling arrangement is used for 90-mm. and 3-in. shell.

Fig. 21 shows an arrangement of the Sparks-Simplex No. 101-A hydraulic manufacturing lathe for the center, gage for length and cut off operation on forged shell bodies. It is suitable for sizes ranging from 75- to 155-mm. of U. S. Army and British designs. Shell are held on an hydraulically-operated expanding arbor bolted to the large spindle flange. The $\frac{1}{4}$-hp. motor mounted on the carriage has a chuck on the end of its shaft for the center drill. The carbide-tipped parting tool is mounted on a

rear tool slide. A 15-hp. motor drives the machine. When operating at a spindle speed of 147 r.p.m. and using a feed of 0.011 in. per rev. for the parting tool, production ranges from 138 per hour for 75-mm. shell to 107 per hour for 155-mm. shell.

Gage for Length and Cut Off

Shell forgings may vary considerably in length and still be within tolerances permitted by Ordnance Department specifications. In some cases the excess stock on the open end is too much to permit combining the cut-off operation with either the centering operation, as just described, or with the rough turning operation as is possible with some set-ups. Such forgings usually must be gaged for length and cut off in a separate operation.

Table VI—HOURLY PRODUCTION FOR HACKSAWING OPEN ENDS

Size of Shell	*Machine Capacity*	*No. of Pieces Cut per Set-Up*	*Production Per Hour*
75-mm.	10 x 10 in.	3	72
90-mm.	10 x 12 in.	3	65
105-mm.	10 x 12 in.	2	38
5-in.	10 x 12 in.	2	20
155-mm.	10 x 16 in.	2	24

Data furnished by Racine Tool & Machine Company.

Various methods have been used for removing the excess length. These include cutting off with single- or double-tool set-ups in either standard or special lathes, sawing by practically any of the common methods, or by "nibbling" with a punch press. While fast, the last method imposes considerable strain on the metal at the nose end of the shell, and the severity of the cut results in rapid wear of the press dies. Lathe-type cutting off machines employing high-speed steel parting tools were used during the last war for this operation and probably will find a similar application during the present program. A simple engine lathe set-up for this operation, developed during the last war by the Hill Pump Company while making 3-in. Russian shrapnel, is shown in Fig. 22. The forging was held in a universal three-jaw chuck. On the tailstock end of the carriage was mounted a support for a gaging bar with which the shell was positioned in the chuck jaws. By bringing the shell to the same position in the jaws each time, the parting tool could be held to a constant distance from the bottom of the cavity. As soon as the work was set and the jaws tightened, the gaging rod was pulled back out of the way. Production with this set-up then ran approximately 40 to 45 per hour.

A number of producers of shell have purchased power hacksaws for cutting forged shell bodies to length, both because of the lower first cost and because they can be used for other work. With the tooling set-up developed by Racine Tool & Machine Company, two or three shell, depending on size, can be cut to length at a time—and the operator easily can serve a battery of machines. Fig. 23 illustrates the tooling employed for shell ranging from 75- to 155-mm. Heavy-duty hydraulic feed machines of 10×10, 10×12 and 10×16 in. capacity have been found suitable. By referring to Fig. 23 it will be noted that the shell are placed in V-ways in the fixture, and are clamped by a quick-acting lever. Gage rods are used to position the shell from the bottom of the cavity. The gage rods are tied together and, when setting shell in position, are moved forward against a stop and clamped. Approximate production data for these set-ups, based on experience in the field, are given in Table VI.

In a test recently conducted by the Peerless Machine Company sawing SAE-X1335 shell stock measuring $6\frac{5}{8}$ in. outside diameter and $4\frac{7}{8}$ in. inside diameter in one of their 14×14 in. high-duty hydraulic feed power hacksaws, cutting time for two shell

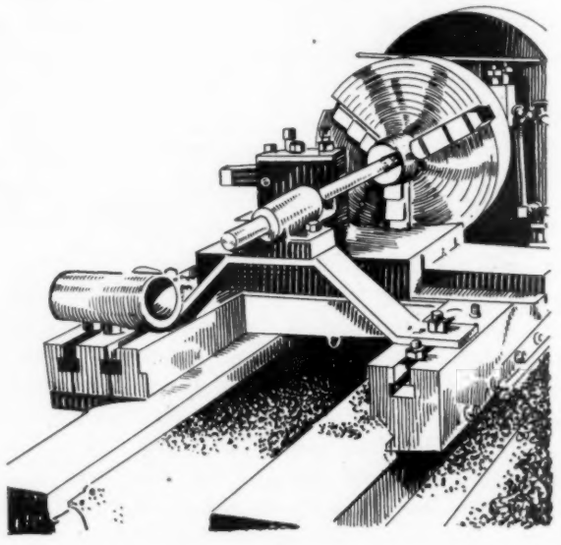


Fig. 22—Used for trimming shell forgings to length during the World War, this lathe set-up was simple, yet positioned the shell quickly in the jaws of the universal chuck. The right setting of the work was obtained with a rod, the end of which butted against the bottom of the cavity. This rod was adjustable in a bracket, and when in gaging position could be locked by a pin that fitted into an offset slot. The rod was pulled back out of the way as soon as the part had been secured in proper relation with the parting tool on the cross-slide

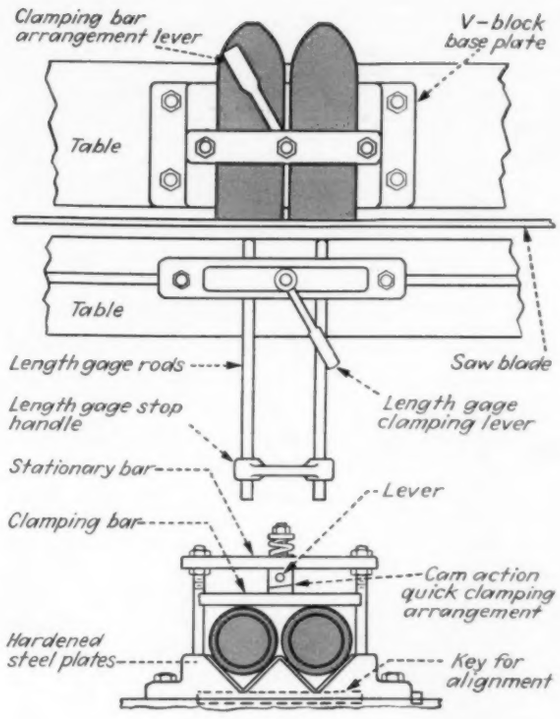
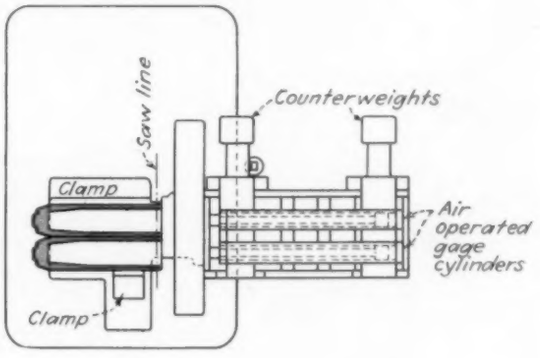


Fig. 23—A simple quick-acting clamp holds two forged shell bodies in hardened steel V-blocks for cutting to length with a Racine power hacksaw. Large shell are cut two at a time, while 75- and 90-mm. shell can be cut three at a time

Fig. 24—This sketch shows the arrangement of a pneumatically-operated gaging fixture on a 14 x 14 in. Peerless power hacksaw for sawing open ends of forged shell bodies to length. Gage unit is raised automatically to permit sawed shell to pass down an inclined conveyor



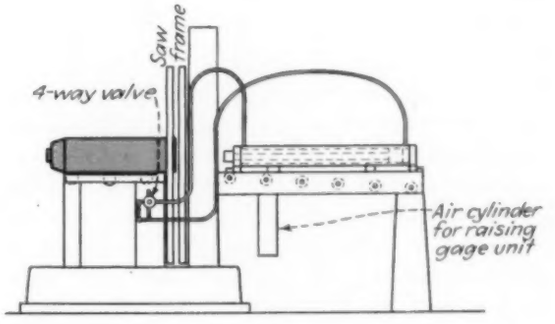
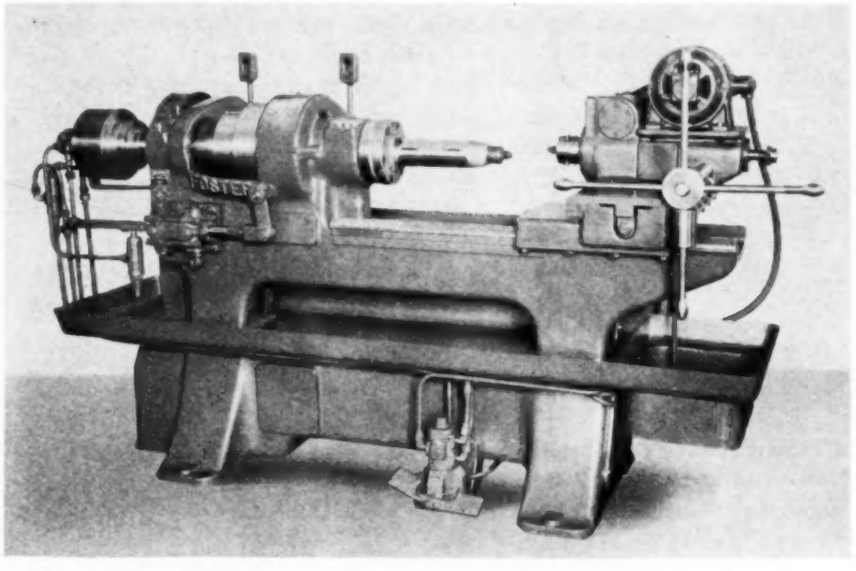


Fig. 25—The Foster shell centering machine has an automatic cycle, except for hand feed of the centering drill and loading and removing shell from the arbor



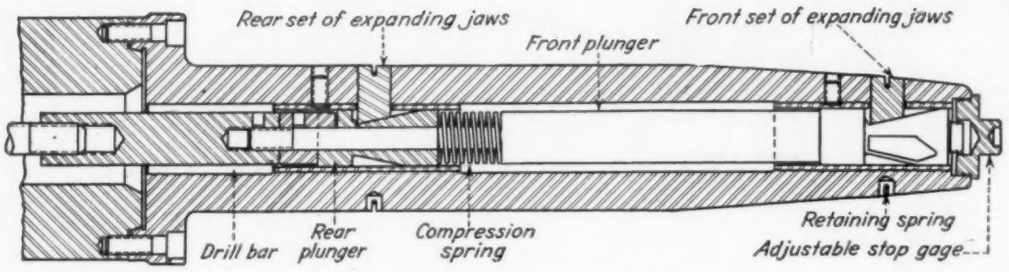


Fig. 26—Developed for the centering machine shown in Fig. 25, this six-jaw expanding arbor is actuated by either an air or hydraulic cylinder

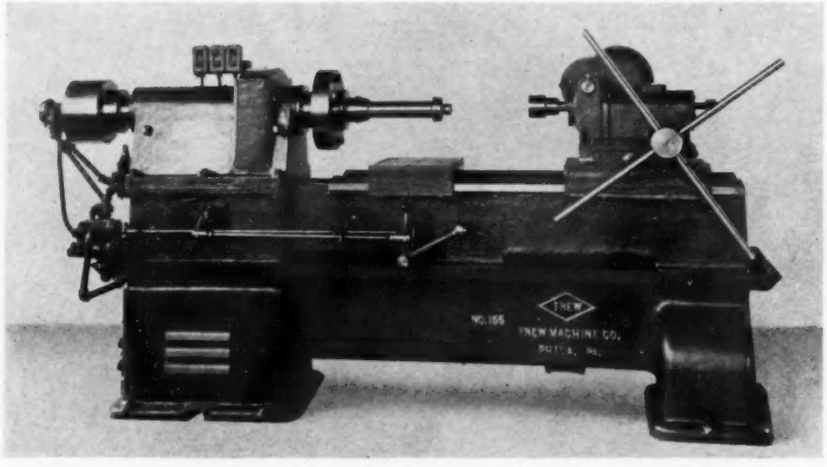


Fig. 27—About 40 to 50 shell of the 105-mm. size can be centered per hour with the Frew single-purpose centering machine. Hand feed is used for the 1-hp. drilling unit

clamped side by side was 2 min. 49 sec. The 21 × 1½ in., 0.065 in. thick, 4-tooth per inch blade used was made of high-speed steel. Cutting rate was better than 11 sq.in. per min. Two gaging and clamping fixtures have been developed by Peerless especially for cutting shell forgings to length on the open end.

The pneumatic fixture shown in Fig. 24 has air operated gages, as well as an air cylinder for raising the gage unit automatically to allow shell to pass down an inclined conveyor after the cut. The two shell are clamped from the sides while resting on a short section of roller conveyor. Once the cut is started the gage rods are withdrawn from the shell. A similar fixture arranged for manual operation also has been developed; in it clamps and gages both are operated by rack and pinion mechanisms. The 14 × 14 in. Peerless machine for which these fixtures have been designed is driven by a 3-hp. motor, and has cutting speeds of 50, 85 and 125 strokes per minute.

Centering as a Separate Operation

During the last war most forged shell bodies were centered in stationary jigs, using vertical, single-spindle drill presses. Present-day centering equipment, however, are arranged to rotate both the shell and the work in order to obtain a more accurately centered piece. Modern centering machines are made in both horizontal and vertical types. They all use expanding arbors for positioning and driving the work piece.

Merely by removing the parting and facing tools from the set-ups shown in Figs. 14, 16, 17, 19, 20 and 21, these machines can be made to serve as simple centering units, with the gage-and-cut-to-length operation either done separately or combined with the rough turning operations as described below. In addition to these machines there are several that are designed only for the centering operation, as they have no provision for mounting parting or facing tools to cut at the open end of the shell.

Among these single-purpose machines is the one shown in Fig. 25, which is made by the Foster Machine Company. This unit has capacity for centering shell from 75- to 155-mm. inclusive, a different arbor being necessary for each size. The Foster expanding arbor, developed for this machine, is shown in detail in Fig. 26. It has two sets of three expanding jaws, like the arbors shown in Fig. 15, with the two sets being spaced far enough apart to insure alignment and concentricity of the shell cavity. An adjustable stop gage extends from the end of each arbor for gaging from the bottom of the cavity. The expanding jaws are operated pneumatically or hydraulically from a cylinder at the other end of the spindle. In this design the cylinder acts directly on

the front plunger. As this plunger moves backward, expanding the front jaws, the heavy spring near the center of the arbor is compressed against the rear plunger, thus expanding the rear set of jaws.

The Foster centering machine has a single-speed spindle carried in Timken bearings and provided with an automatic brake for quick stopping. The saddle carrying the motor-driven drill head may be moved along the ways to predetermined positions and locked in place. Also, the drill head has a cross-sliding movement which permits moving the drill head to the rear of the machine so there will be no interference when loading or removing work pieces. With the exception of hand feed for the center drill, all the rest of the operation cycle is automatic. Spindle is driven with a 3-hp. motor, while a 1-hp. motor is used for the drill head. Production rates which can be maintained with this machine range from 875 to 900 per 8-hr. day for 75-mm. shell, to 270 to 280

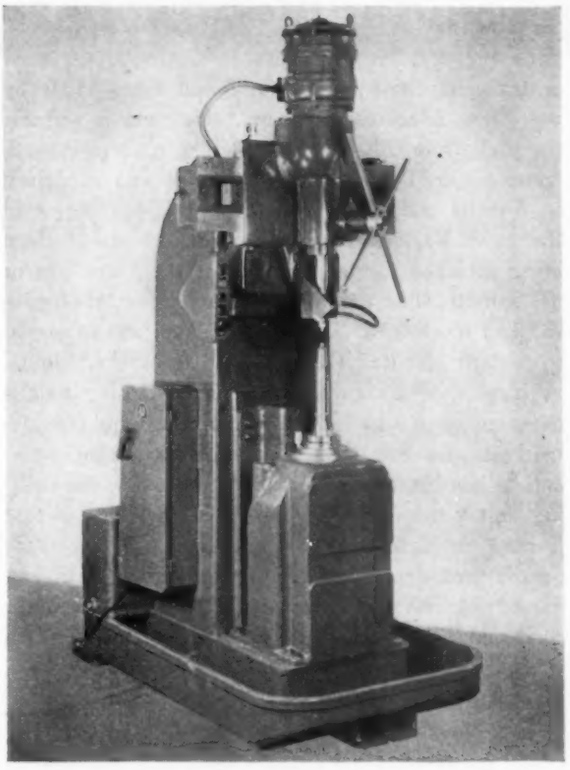
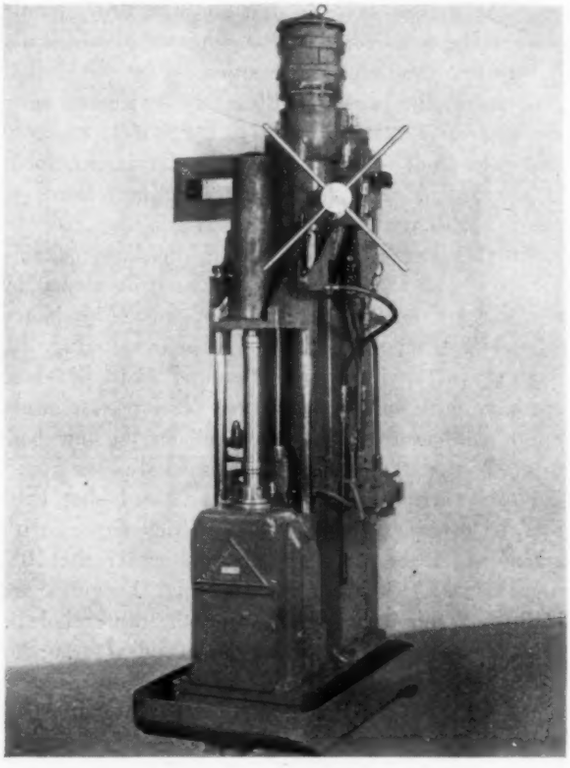


Fig. 28—The small LeMaire shell centering machine has capacity for 3-in. and 75-mm. shell. Drill spindle is moved aside hydraulically to facilitate loading and unloading of shell on the vertical arbor



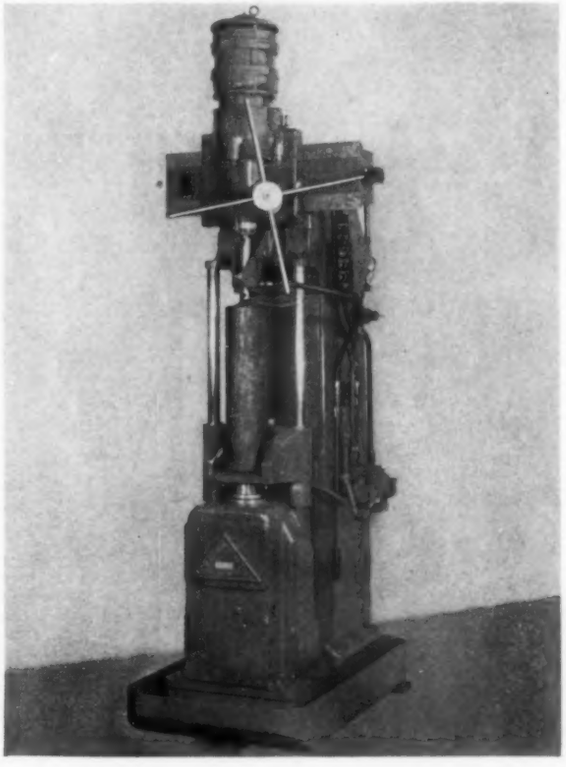


Fig. 29—At the left is shown the 6-in. capacity LeMaire shell centering machine with the hydraulic elevator raised for removal of a centered shell. In the view at the right a shell has been lowered and clamped, and the drill spindle has been shifted ready for drilling. Cycle is automatic except for hand feed of drill into work. Return of spindle automatically reconnects cycle controls

per 8-hr. day for the 155-mm. high explosive shell.

In Fig. 27 is shown another single-purpose shell centering machine of the horizontal type. Made by the Frew Machine Company, this unit is suitable for shell from 90- to 155-mm. The main spindle is mounted in Timken roller bearings and is driven by V-belts and silent chain from a 2-hp. motor in the base. Various types of arbors are used; these being attached to the faceplate at the front end of the spindle. The drilling unit, located at the opposite end of the bed, consists of a 1-hp. motor geared to a drill spindle. The operator feeds this spindle by hand with a capstan wheel. The drilling unit is mounted on a slide which is moved at right angles to the center line of the bed by an hydraulic cylinder. When loading or unloading the arbor, the drilling unit is moved to the rear of the machine so that it does not interfere with movement of the shell. Speeds used depend on the size of center drills employed; on one job where a $\frac{7}{8}$-in. drill was used, the shell spindle was revolved at 200 r.p.m. and the drill revolved at 700 r.p.m. in the opposite direction, giving an effective drill speed of 900 r.p.m.

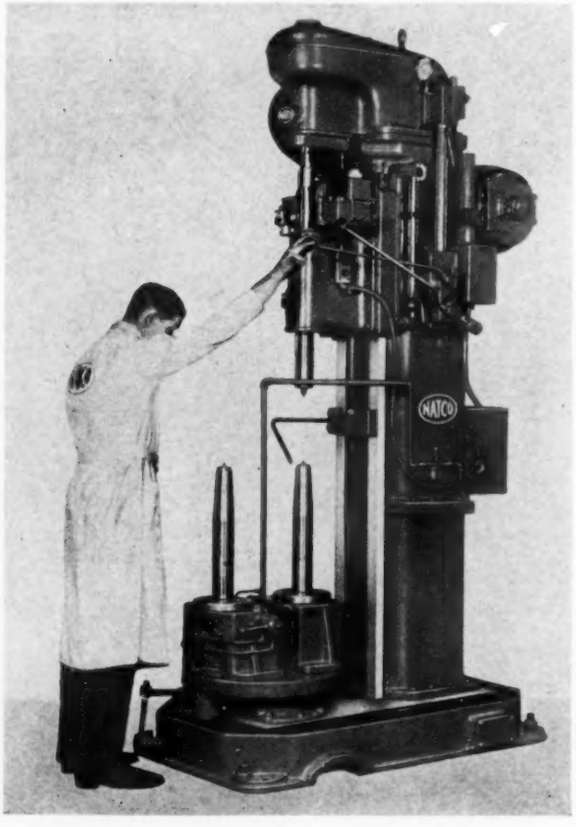


Fig. 30—By using two centering arbors on an indexing fixture for this shell centering machine the spindle is kept working a larger percentage of the time

Two sizes of a vertical shell centering machine have been made available by LeMaire Tool & Manufacturing Company. As with most other centering machines, trimming of the open end of the shell is not necessary before centering on these machines. The smaller machine for 3-in. and 75-mm. shell, shown in Fig. 28, differs from the larger machine principally in the fact that it is not equipped with an elevating device, as shell within its capacity are light enough to be handled easily. The smaller unit can center 120 to 140 pieces per hour.

Shown in Fig. 29 is the larger LeMaire centering machine, which has capacity for 90-, 105- and 155-mm. shell as well as 5.5- and 6-in. sizes, and will center 90 to 120 pieces per hour. In this machine the shell is lowered over the inverted arbor which centers and drives the shell in the same manner as arbors used on horizontal machines. Cycle of operation is as follows: (1) with the drill spindle moved aside, shell is loaded onto platform from conveyor, which is on a level with the platform in its upper position; (2) operator presses cycle button to lower shell over arbor and automatically clamp it in place, after shell is lowered drill spindle automatically shifts over to align with center of shell; (3) operator drills center hole with hand feed; (4) operator presses cycle button to shift drill spindle aside, when spindle is clear the platform automatically is raised to the unloading position where the shell is returned to the conveyor. Elevating device and spindle slide are actuated by hydraulic cylinders and control is by limit switches. Elevating device movement is interlocked with horizontal slide movement, so the two will not interfere.

Another vertical shell centering machine, suitable for 105- and 155-mm. shell, has been developed by the National Automatic Tool Company. This Natco Model B-225H vertical machine, shown in Fig. 30, is arranged with a semi-automatic hydraulic feed complete with an automatic time delay reverse mechanism and positive stop. Mounted on the low base is a 22-in. diameter two-position hand-index rotating table arranged with a foot-operated shot bolt. On the rotating table is a two-position fixture with expanding arbors arranged to hold either the 105-mm. or the 155-mm. shell forging. Forgings are loaded on the front arbor, while the center hole is being drilled in a forging on the second arbor under the spindle. Using a $\frac{7}{8}$ in. diameter high-speed steel center drill at 200 r.p.m., and a feed rate of 0.010 in. per rev., the production cycle totals 36 sec. and the estimated production is 100 shell per hour.

The second of this series discussing various methods used for machining high-explosive shell will appear in an early number.

TIME-DATA SHEET NO. 31

Sensitive Drill Press Operations—VII

(*Continued from Time-Data Sheet No. 30*)

Operation Symbol	Description of Operation	Allowed Time Std. Hours
E_1	Clean table of machine — No. 2 machine	0.0204
F_1	Clean table of machine — No. 3 machine	0.0326
G_1	Collect and put away tools	0.0084
H_1	Remove drill, grind and replace (special jobs only)	0.0349
J_1	Turn on, adjust and turn off coolant supply	0.0036
K_1	Clean machine weekly	0.2500
L_1	Pick up very small part and put on table or in vise	0.0008
M_1	Pick up very small part and lay aside	0.0006
N_1	Pick up small part and put on table or in vise	0.0011
P_1	Pick up small part and lay aside	0.0008
Q_1	Pick up medium part and put on table or in vise	0.0021
R_1	Pick up medium part and lay aside	0.0016
S_1	Pick up large part and put on table or in vise	0.0035
T_1	Pick up large part and lay aside	0.0028
U_1	Pick up very small part and put in jig	0.0011
V_1	Remove very small part from jig and lay aside	0.0008
W_1	Pick up small part and put in jig	0.0016
X_1	Remove small part from jig and lay aside	0.0011
Y_1	Pick up medium part and put in jig	0.0029
Z_1	Remove medium part from jig and lay aside	0.0021
A_2	Pick up large part and put in jig	0.0048
B_2	Remove large part from jig and lay aside	0.0035
C_2	Tighten vise by hand — very small or small part	0.0006
D_2	Release vise by hand — very small or small part	0.0004
E_2	Tighten vise by hand — medium part	0.0014
F_2	Release vise by hand — medium part	0.0008
G_2	Tighten vise by hand — large part	0.0026
H_2	Release vise by hand — large part	0.0013
J_2	Hit part and tighten vise with rawhide mallet	0.0031

Table No. 7—Tap Bronze, Malleable Iron, Cold Rolled or Cast Steel

Size of Tap	BRONZE — Depth of Hole in Inches								MALLEABLE IRON — Depth of Hole in Inches							
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1
4–40	0.0006	0.0009	0.0013	0.0016	0.0019	0.0023	0.0026	0.0030	0.0008	0.0012	0.0016	0.0020	0.0024	0.0029	0.0033	0.0037
6–32	0.0007	0.0010	0.0013	0.0016	0.0020	0.0023	0.0026	0.0030	0.0008	0.0012	0.0017	0.0021	0.0025	0.0029	0.0033	0.0037
8–32	0.0008	0.0012	0.0016	0.0020	0.0024	0.0027	0.0031	0.0035	0.0010	0.0015	0.0020	0.0025	0.0029	0.0034	0.0039	0.0044
10–32	0.0009	0.0014	0.0018	0.0023	0.0027	0.0032	0.0036	0.0041	0.0011	0.0017	0.0023	0.0029	0.0034	0.0040	0.0046	0.0051
14–24	0.0010	0.0014	0.0019	0.0023	0.0027	0.0032	0.0036	0.0040	0.0013	0.0018	0.0024	0.0029	0.0034	0.0040	0.0045	0.0051
1/4–20	0.0010	0.0013	0.0017	0.0021	0.0025	0.0028	0.0032	0.0036	0.0012	0.0017	0.0022	0.0026	0.0031	0.0036	0.0040	0.0045
5/16–18	0.0012	0.0016	0.0020	0.0024	0.0028	0.0033	0.0037	0.0041	0.0015	0.0020	0.0025	0.0030	0.0036	0.0041	0.0046	0.0051
3/8–16	0.0013	0.0018	0.0022	0.0027	0.0031	0.0036	0.0040	0.0045	0.0017	0.0022	0.0028	0.0034	0.0039	0.0045	0.0051	0.0056
1/2–13	0.0017	0.0022	0.0027	0.0032	0.0036	0.0041	0.0046	0.0051	0.0021	0.0027	0.0033	0.0039	0.0045	0.0052	0.0058	0.0064
5/8–11	0.0020	0.0026	0.0030	0.0035	0.0040	0.0045	0.0051	0.0056	0.0025	0.0032	0.0038	0.0044	0.0051	0.0057	0.0064	0.0070
3/4–10	0.0024	0.0029	0.0035	0.0040	0.0046	0.0052	0.0057	0.0063	0.0029	0.0037	0.0044	0.0051	0.0058	0.0065	0.0072	0.0079

Size of Tap	COLD ROLLED STEEL — Depth of Hole in Inches								CAST STEEL — Depth of Hole in Inches							
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1
4–40	0.0009	0.0014	0.0019	0.0024	0.0029	0.0034	0.0039	0.0044	0.0010	0.0016	0.0021	0.0027	0.0032	0.0038	0.0044	0.0049
6–32	0.0010	0.0015	0.0020	0.0025	0.0030	0.0035	0.0040	0.0045	0.0011	0.0017	0.0022	0.0028	0.0033	0.0039	0.0044	0.0050
8–32	0.0012	0.0018	0.0024	0.0030	0.0035	0.0041	0.0047	0.0053	0.0013	0.0020	0.0026	0.0033	0.0039	0.0046	0.0052	0.0059
10–32	0.0014	0.0021	0.0027	0.0034	0.0041	0.0048	0.0055	0.0062	0.0015	0.0023	0.0030	0.0038	0.0045	0.0053	0.0061	0.0068
14–24	0.0015	0.0022	0.0028	0.0035	0.0041	0.0048	0.0054	0.0061	0.0017	0.0024	0.0031	0.0039	0.0046	0.0053	0.0060	0.0068
1/4–20	0.0015	0.0020	0.0026	0.0031	0.0037	0.0043	0.0048	0.0054	0.0016	0.0022	0.0029	0.0035	0.0041	0.0047	0.0054	0.0060
5/16–18	0.0018	0.0024	0.0030	0.0036	0.0043	0.0049	0.0055	0.0062	0.0019	0.0026	0.0033	0.0040	0.0048	0.0055	0.0062	0.0069
3/8–16	0.0020	0.0027	0.0034	0.0040	0.0047	0.0054	0.0060	0.0067	0.0022	0.0030	0.0037	0.0045	0.0052	0.0060	0.0067	0.0075
1/2–13	0.0025	0.0033	0.0040	0.0047	0.0054	0.0062	0.0069	0.0076	0.0028	0.0036	0.0044	0.0053	0.0061	0.0069	0.0077	0.0085
5/8–11	0.0030	0.0038	0.0046	0.0053	0.0061	0.0069	0.0077	0.0084	0.0034	0.0042	0.0051	0.0059	0.0068	0.0076	0.0085	0.0094
3/4–10	0.0035	0.0044	0.0052	0.0060	0.0069	0.0077	0.0086	0.0094	0.0039	0.0048	0.0058	0.0067	0.0076	0.0086	0.0095	0.0104

(*Continued on Time-Data Sheet No. 32*)

Opening Up

BOTTLE NECKS

Machines mounted on New Departure Ball Bearings run smoothly, work accurately, perform reliably because New Departure precision is built on a bed rock of Forged Steel. New Departure, a division of General Motors, Bristol, Connecticut. Detroit and Chicago.

NEW DEPARTURE

THE FORGED STEEL BEARING

2969

TIME-DATA SHEET NO. 32

Sensitive Drill Press Operations—VIII

(*Continued from Time-Data Sheet No. 31*)

Operation Symbol	Description of Operation	Allowed Time Std. Hours
K_2	Release vise with rawhide mallet	0.0012
L_2	Turn very small or small part over in vise	0.0008
M_2	Turn medium part over in vise	0.0022
N_2	Turn large part over in vise	0.0034
P_2	Turn very small or small part over on table	0.0005
Q_2	Turn medium part over on table	0.0010
R_2	Turn large part over on table	0.0020
S_2	Turn small jig over halfway (90 deg.)	0.0005
T_2	Turn medium jig over halfway (90 deg.)	0.0011
U_2	Turn large jig over halfway (90 deg.)	0.0014
V_2	Turn small jig completely over (180 deg.)	0.0007
W_2	Turn medium jig completely over (180 deg.)	0.0016
X_2	Turn large jig completely over (180 deg.)	0.0023
Y_2	Move very small or small part, jig or vise to first spindle, or from spindle to spindle	0.0007
Z_2	Move medium part, jig or vise to first spindle, or from spindle to spindle	0.0012
A_3	Move large part, jig or vise to first spindle, or from spindle to spindle	0.0016
B_3	Move very small or small part, jig or vise from hole to hole under same spindle	0.0005
C_3	Move medium part, jig or vise from hole to hole under same spindle	0.0008
D_3	Move large part, jig or vise from hole to hole under same spindle	0.0010
E_3	Clean small jig with brush	0.0020
F_3	Clean medium jig with brush	0.0028
G_3	Clean large jig with brush	0.0035
H_3	Clean small jig by turning over	0.0014
J_3	Clean medium jig by turning over	0.0022
K_3	Clean large jig by turning over	0.0029
L_3	Clean small or medium jig with air hose	0.0014
M_3	Clean large jig with air hose	0.0020
N_3	Tighten one short locating screw by hand	0.0010
P_3	Release one short locating screw by hand	0.0008
Q_3	Tighten two short locating screws by hand	0.0013
R_3	Release two short locating screws by hand	0.0010

Table No. 8—Drill and Tap Brass, Cast Iron, Copper or Annealed Steel

Size of Tap	BRASS — Depth of Hole in Inches								CAST IRON — Depth of Hole in Inches							
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1
4–40	0.0005	0.0008	0.0011	0.0013	0.0017	0.0020	0.0023	0.0027	0.0008	0.0013	0.0019	0.0024	0.0029	0.0034	0.0040	0.0045
6–32	0.0006	0.0008	0.0011	0.0014	0.0017	0.0020	0.0023	0.0027	0.0009	0.0014	0.0019	0.0024	0.0029	0.0035	0.0040	0.0045
8–32	0.0006	0.0009	0.0013	0.0016	0.0019	0.0023	0.0026	0.0030	0.0009	0.0015	0.0021	0.0027	0.0033	0.0039	0.0044	0.0050
10–32	0.0007	0.0011	0.0015	0.0019	0.0022	0.0027	0.0031	0.0034	0.0011	0.0017	0.0023	0.0029	0.0037	0.0043	0.0049	0.0055
14–24	0.0008	0.0012	0.0016	0.0020	0.0023	0.0028	0.0032	0.0035	0.0012	0.0018	0.0025	0.0031	0.0038	0.0044	0.0050	0.0056
1/4–20	0.0008	0.0011	0.0015	0.0019	0.0022	0.0026	0.0030	0.0033	0.0012	0.0017	0.0024	0.0029	0.0036	0.0041	0.0047	0.0053
5/16–18	0.0009	0.0013	0.0018	0.0022	0.0026	0.0029	0.0033	0.0038	0.0014	0.0020	0.0027	0.0032	0.0039	0.0046	0.0052	0.0059
3/8–16	0.0011	0.0015	0.0020	0.0024	0.0028	0.0033	0.0037	0.0042	0.0016	0.0023	0.0029	0.0036	0.0043	0.0050	0.0057	0.0063
1/2–13	0.0013	0.0018	0.0023	0.0027	0.0032	0.0038	0.0042	0.0047	0.0020	0.0028	0.0036	0.0043	0.0051	0.0059	0.0066	0.0073
5/8–11	0.0017	0.0021	0.0026	0.0032	0.0036	0.0042	0.0047	0.0051	0.0025	0.0032	0.0041	0.0049	0.0057	0.0065	0.0073	0.0081
3/4–10	0.0019	0.0024	0.0030	0.0036	0.0041	0.0047	0.0053	0.0058	0.0029	0.0038	0.0048	0.0056	0.0065	0.0074	0.0083	0.0091

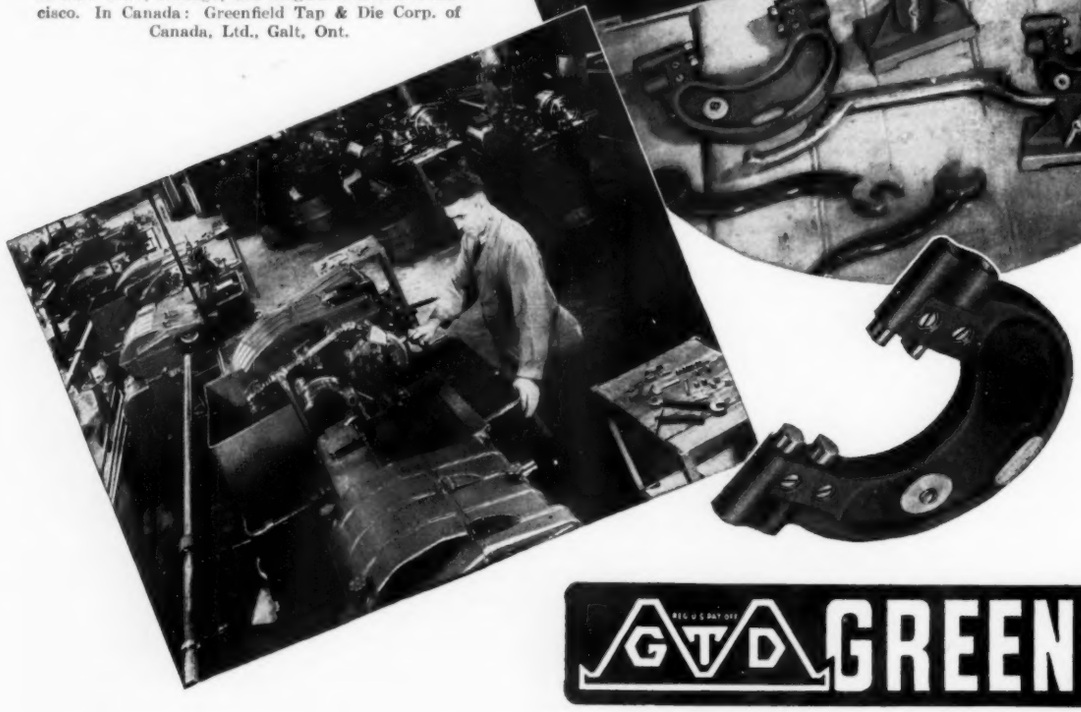
Size of Tap	COPPER — Depth of Hole in Inches								ANNEALED STEEL — Depth of Hole in Inches							
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1
4–40	0.0008	0.0014	0.0019	0.0025	0.0030	0.0036	0.0041	0.0047	0.0010	0.0016	0.0022	0.0028	0.0034	0.0040	0.0047	0.0053
6–32	0.0009	0.0014	0.0020	0.0025	0.0031	0.0036	0.0041	0.0047	0.0010	0.0016	0.0022	0.0029	0.0035	0.0041	0.0047	0.0053
8–32	0.0010	0.0016	0.0022	0.0028	0.0034	0.0040	0.0046	0.0052	0.0011	0.0018	0.0025	0.0032	0.0039	0.0046	0.0052	0.0059
10–32	0.0012	0.0018	0.0024	0.0031	0.0038	0.0044	0.0051	0.0057	0.0014	0.0021	0.0028	0.0035	0.0044	0.0051	0.0058	0.0065
14–24	0.0013	0.0019	0.0026	0.0032	0.0039	0.0045	0.0052	0.0059	0.0015	0.0022	0.0030	0.0037	0.0045	0.0052	0.0059	0.0067
1/4–20	0.0012	0.0018	0.0025	0.0030	0.0037	0.0043	0.0049	0.0055	0.0014	0.0021	0.0029	0.0035	0.0042	0.0049	0.0055	0.0063
5/16–18	0.0015	0.0021	0.0028	0.0034	0.0041	0.0048	0.0054	0.0061	0.0017	0.0024	0.0032	0.0039	0.0047	0.0055	0.0062	0.0069
3/8–16	0.0017	0.0024	0.0030	0.0038	0.0045	0.0052	0.0060	0.0066	0.0020	0.0028	0.0035	0.0043	0.0051	0.0060	0.0068	0.0075
1/2–13	0.0021	0.0029	0.0038	0.0045	0.0053	0.0061	0.0069	0.0076	0.0025	0.0033	0.0043	0.0052	0.0060	0.0070	0.0078	0.0087
5/8–11	0.0026	0.0034	0.0042	0.0051	0.0059	0.0068	0.0075	0.0084	0.0030	0.0039	0.0048	0.0058	0.0067	0.0077	0.0086	0.0095
3/4–10	0.0030	0.0039	0.0050	0.0059	0.0068	0.0077	0.0086	0.0095	0.0035	0.0045	0.0057	0.0067	0.0077	0.0087	0.0098	0.0108

(*Continued on Time-Data Sheet No. 33*)

We know the importance of GAGES from experience

Nearly fifty years ago Greenfield Tap & Die Corporation began to manufacture gages—because the open market didn't afford the accuracy and reliability we required. Today all our manufacturing operations are checked with the proper gages.

The recognized accuracy and reliability of "G.T.D. Greenfield" Gages has resulted in the present country wide demand for them. Our Gage Division — already one of the largest in the country, will be more than doubled when present construction is completed. We shall continue to build the best gages that can be made, and to further expand our gage engineering service.



GREENFIELD TAP & DIE CORPORATION
Greenfield, Massachusetts

Detroit Plant: 2102 West Fort Street. Warehouses in New York, Chicago, Los Angeles and San Francisco. In Canada: Greenfield Tap & Die Corp. of Canada, Ltd., Galt, Ont.

GTD GREENFIELD

TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES · PIPE TOOLS

Delivering The Goods

Don't make any mistake about it. Industry is on a spot in the defense program and must deliver the goods as rapidly as possible. If it fails, there are willing hands in Washington, unsympathetic to industry, ready and eager to take over.

What can the metal-working industry do to help speed up defense production and deliver the goods so badly needed by our own military and naval forces and by Britain? Many things. To name only a few:

Some shops have on hand machine tools which they are not using and for which they probably cannot find employment. Yet they often will not let them go, except perhaps at exorbitant prices. Cases have occurred, according to reliable reports, where companies have held out for prices on twenty-year-old machines approximating those for 1940 types.

That kind of practice has retarded putting available equipment into service at the places where it is most needed. For patriotic reasons as well as for the success of industry in carrying out its defense responsibilities, shops having surplus used machinery should be willing to release it at reasonable prices. We cannot afford to be accused of placing the dollar mark on our patriotism.

The fact has been demonstrated more than once that some companies are not getting the most out of the machine tools in their plants. One machine tool builder recently was called in to the plant of a user, who said that he *must* have certain new machines quickly to enlarge munitions production. After a thorough inspection, the builder said, "You don't require more machines to get the volume you want. All you must do is to *work your machines faster.*"

As it turned out, the machines in that factory were running at about eighty per cent of their rated capacity. They could easily have been operated at one hundred per cent with a comfortable margin of safety left. That would have meant twenty per cent more production. The fault lay not with the workers, but with lax management. It hadn't painstakingly gone at the job of getting the most out of its equipment. All shops engaged in defense manufacture should look into whether they are letting their machines loaf on the job rather than go full tilt.

On the human side, the biggest thing industry can do is *to get serious about the defense program.* The time for holding back is over. An "all-out" effort is imperative, and no fooling about it. Many industrialists are contributing such efforts now, but not all companies.

Employees can do their part by helping to get more out of the machines which they run. Our only hope of going through with our program on time is to secure higher productivity per worker, and that means more output per machine. They should not lose sight of the fact that they have just as much at stake as industry in keeping our democratic way of life unimpaired.

If every manufacturer would talk to his men at least once every month about his defense manufacturing problems, he would go a long way toward enlisting their help and understanding.

These are only a few of the things that can and must be done if industry is to make good on the biggest assignment ever given it. It must deliver the goods, or confess failure and let those who are hostile to it get into the saddle. We are confident that industry will deliver the goods.

Burnham Finney

GAGING BUSINESS

More and more work is sub-contracted by machine tool builders. Maritime Commission asks for an additional $65,000,000 to step up its ship program. Steel production is crowded to capacity

Machine Tools—Machine tool builders are resorting more than ever before to farming out work, both parts and complete machines, to help meet the overwhelming demand for machine tools. Companies not remotely connected with machine tool manufacture but which do excellent machining work, such as a can maker and a laundry machine firm and several printing machinery builders, are manufacturing machine tools or parts. The British Purchasing Commission, badly in need of machine tools, are reported placing $40,000,000 of machine tool orders to be made outside the machine tool industry itself. This is in addition to the more than $100,000,000 of machine tools on order with regular builders. Defense authorities in Washington, to speed up manufacture of machine tools, are beginning to award large blanket contracts for certain sizes and types of machines rather than sticking to rigid requirements for a particular munitions line or plant. This so-called "float order" policy has been pursued for a long time by British purchasing officials in this country. A machine tool priorities committee, with an impartial chairman and an arbitrator at the head, has just been set up in Washington though its duties are not yet clearly defined. It should assist materially in expediting production of machine tools for defense purposes. Large awards for new aircraft engine plants still are coming through. Important orders for training school equipment have been placed, but deliveries will be very slow because they have had no priority rating.

Aircraft—Plane output is back up close to where it was last August. Production in January was between 800 and 900 planes, of which 60 per cent were combat types. The four large assembly plants where bomber units built by automobile companies will be assembled will be ready late in 1941. The three largest motor car makers—General Motors, Chrysler and Ford—are expected to take on more responsibility for the bomber parts program sponsored by the Automotive Committee for Air Defense. Many of their automobile parts suppliers are expected to become sub-contractors on aircraft parts.

Shipbuilding — The Maritime Commission is asking Congress for $65,000,000 contract authority to step up its regular 50-ships-a-year program so that it will total 200 by July 1. This program is for the regular "C" ships and should not be confused with the other program for 200 so-called "pointed boxes" for the emergency. All private as well as commercial yards are loaded with work. Bethlehem Shipbuilding alone has a backlog of over $1,000,000,000 for ship construction and repair.

Munitions — The Army has ordered construction of a bag-loading plant to cost $15,227,080 at Charlestown, Ind., near the site of the new smokeless powder operation. It will be managed by Goodyear Engineering Corp. The Marietta Mfg. Co., Point Pleasant, W. Va., will supply mine planters totaling $8,241,750. Large orders have come through for artillery ammunition components, including $3,780,000 to Scovill Mfg. Co., Waterbury, Conn., $5,550,000 to Elgin National Watch Co., Chicago, and $2,910,000 to the Norwalk Lock Co., South Norwalk, Conn.

Railroad Equipment — January orders and inquiries indicate that 1941 will show continued improvement. orders for about 40 locomotives and inquiries for double that number were received the past month. Some 12,000 freight cars, including 8,045 from company shops, are to be built; bids have been submitted on 5,500 cars. Passenger train business also got off to a good start with New York Central's decision to buy two stainless steel streamliners and Missouri Pacific's intention of purchasing two complete trains. South African Railway is in the market for 1,000 freight cars, and Canadian National for 725 cars. The New Haven plans to buy 1,000 box cars, 25 cabooses, five grill cars and 15 locomotives.

Steel—Defense tonnage is crowding the steel mills to full capacity. The main problem ahead will be to see that steel needed quickly for defense projects is rolled and delivered without causing too much disruption to regular customers. Steel leaders point out that the country's ingot capacity is three to four times as much as any possible requirements for defense and aid to Britain. The maximum tonnage for armament production and for shipment to England is put at 20,000,000 tons, and the industry's capacity is 83,000,000 tons. The automotive industry is a heavy buyer just now.

•

Farm Equipment—Farm income for 1941 starts at a slightly higher level than last year's. Just as the manufacturing season is going strong, International Harvester's Chicago tractor works and Allis-Chalmers' Milwaukee plant, including the tractor factory, have been closed by strike. Harvester's East Moline plant reopened last week after an eight-days' strike. The union wants piecework abolished, the hiring rate put at 75 cents, wage inequalities adjusted and a year's pay granted to draftees.

Three-man Commission Works on Sub-contracting

WASHINGTON — The War Department, in its attempts to push sub-contracting, is working primarily with the machinery set up by Donald Nelson's old Office of Small Business Activity. The Trecker Brothers, Francis and Joseph, who were called in by the Army from their Minneapolis machine tool business, have been combined with Robert L. Mehornay, number two man in Small Business Activities, into a three-man commission on the problem. Attached to the production division of OPM this commission will work at the job of getting contractors and sub-contractors together. Sidney Hillman's Morris L. Cooke, who was first to start preaching the gospel of sub-contracting, is apparently left somewhat off the main line to deal with the fellow who is so small he can't even take a sub-contract and should form a local pool with others in the same fix.

Three main lines of approach are already on the Commission's docket. First is to liven up the system of contact men in the 36 federal reserve banks and branch banks. Each bank has assigned an officer to deal with would-be sub-contractors. In some places this has worked well, in others not so well. The plan now is for the Commission to name its own man in each bank. They will be production men rather than bankers. The reserve banks have agreed to pay salaries and provide clerical staff.

To aid these contact men, a list of the 13,000 or so prime defense contracts so far awarded has been prepared, classified by federal reserve districts. In preparation is a list of some 130,000 firms available for sub-contracts.

An attempt is being made to have the Army write its specifications in such a way as to guide the prime contractor in splitting up his work. Specifications applying to each element of the work which can readily be sub-contracted would be put on a separate sheet.

Big Staff Expansion in Production Division Of OPM Reflects Change From Advisory Body

WASHINGTON—Big staff expansion of OPM's Production Division (which combines the old production and raw materials division of Defense Commission) is in prospect. Typical is a group dealing with aircraft design; its eight-man staff will grow to 75. This reflects the change from an advisory to a working body, but it does not mean that OPM will absorb (yet) any of the regular functions of the War and Navy departments. It sees itself as a trouble-shooter, will get to work when something interrupts the smooth flow of procurement.

The broad advisory function is retained, and indeed renewed, with the formation of a Production Planning Board responsible to director Biggers, Production Division. Experience has been that the staff of the supposedly advisory Defense Commission became too engrossed in detail to do much long-range planning. The Board will be free to sit and think; its first job will be review of the work done up to date. Membership has not been determined.

Follow Principle of OPM

Though the motive is different, the two-man principle that set Knudsen and Hillman at the head of OPM is being followed generally in the organization of the production division. Each responsible executive will have a deputy. Thus, without tying officials to their desks, there will always be someone with authority on deck. So far the only deputies named have been William L. Batt, deputy director of production, and A. C. C. Hill, deputy director of priorities.

Second major personnel policy has been to put men in charge of industrial problems drawn from outside that industry in order to avoid unconscious bias. Examples are: George M. Moffett, Corn Products Refining, to head mining and mineral products; and publishers Merrill C. Meigs, Chicago Herald-American, and Mason Britton, McGraw-Hill Publications, who look after aircraft and machine tools respectively.

The production division, under Biggers and Batt, is broken down into three broad classifications, each with its sub-organization. Of particular interest to metal-working manufacturers is the section headed by E. F. Johnson, General Motors, which has the tough job of looking after products where practically a new industry has to be created—aircraft and ordnance—and the closely related machine tools. Meigs remains in charge of aircraft under Johnson. Ordnance is the responsibility of A. R. Glancy of Pontiac, while Britton handles tools as under the Defense Commission.

The Industrial Materials Division of the Defense Commission now becomes a section of OPM's production division and is headed by Averell Harriman of the Union Pacific R.R. Under Harriman, Moffatt heads mining and mineral products.

Shipbuilding has been combined with construction into another section headed by W. H. Harrison of A.T.&T., who headed construction on the Defense Commission. Because of his close relations with the Quartermaster Corps, Harrison will handle also whatever production problems arise in connection with equipment and supplies like trucks and uniforms. Emory S. Land, chairman, Maritime Commission, will look after ships for Harrison, while supplies come under J. C. Nichols, J. C. Nichols Investment Co., Kansas City. No one has yet been placed in immediate charge of construction.

Plane Deliveries of 1940 Valued Twice That of 1939

WASHINGTON—The aircraft industry delivered $544,440,000 worth of planes, engines and propellers in calendar 1940, more than double the $225,000,000 worth in 1939, the Aero Chamber of Commerce reports. Factory space increased from 7,410,133 sq.ft. to 12,664,600 during the year, which ended with another 16,000,000 under construction. Engine space expanded to 5,272,479 sq.ft., with work in progress toward 10,000,000 sq.ft. Propeller space more than doubled.

Ship More Planes to Britain

Nearly 1,900 planes went to Britain and Canada in 1940, as compared with 300 in 1939, an increase of 600%. January-June deliveries totaled 275; July-December, over 1,600. Total exports were 3,450, of which 750 went to France.

Knudsen says the auto-parts-assembly plants will start during last quarter of 1941. He said auto production will not be interfered with. Meanwhile, the Air Corps started a survey to determine status of production and to determine probable delivery dates. Officers are still doubtful of getting 25,000 planes by July, 1942.

Cannon of 20 to 37-mm. are being installed on some types for the U. S. Air Corps and Britain, and the .50 caliber machine gun is all but replacing the .30 caliber which cannot pierce the new armor used on German bombers. One ship being delivered to the British, presumably the P40-D, now carries six guns, which is the nearest approach we have made to the eight-gun fighters. The Allison 2,000-hp. model is reported ready to go on a production basis.

Impartial Chairman

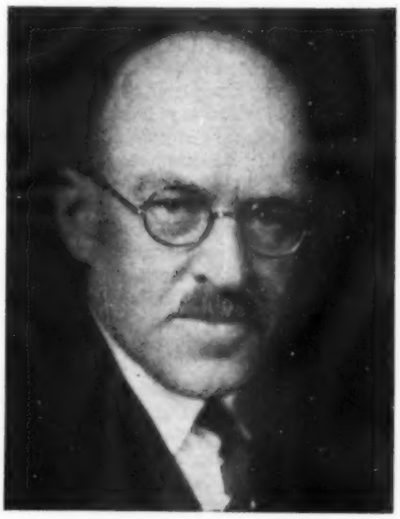
DEXTER S. KIMBALL

Kimball and Flanders Head Machine Tool Committee

WASHINGTON—Dexter S. Kimball, dean emeritus of engineering, Cornell University, has been named impartial chairman of the Machine Tool Priorities Committee and Ralph E. Flanders, president, Jones & Lamson Machine Co., has been named administrator of the committee. General Hayes, U.S. Ordnance Department, will represent the Army while Capt. Almy will represent the Navy. Frederick V. Geier, president, National Machine Tool Builders' Association, will represent industry. Mason Britton, vice-president, McGraw-Hill Publishing Co., will act as consultant to the committee.

Dexter Kimball, consulting editor on industrial organization and management, McGraw-Hill Publishing Co., has authored books on industrial economics and organization. He is also a past president, American Society of Mechanical Engineers.

Machine Tool Administrator



RALPH E. FLANDERS

FEDERAL TRAINING OF LABOR AIDS DEFENSE

Training within industry and pre-job training are supervised by the Labor Division of the National Defense Advisory Commission

WASHINGTON—Federal training of skills for defense divides into two parts: (1) Training Within Industry, or upgrading, and (2) Labor Supply and Training, or pre-job training. Both are sections of the Labor Division of the Defense Commission.

The purpose of the Training Within Industry section is to advise and assist the defense industries in speeding the training and increasing the skills of employed persons. This section has no appropriations; its only costs are the salaries of the Washington and field staffs.

The purpose of the Labor Supply and Training section is primarily to coordinate the seven federal agencies participating in basic or primary training for defense, to classify these trainees, and feed them into the industry upgrading system in an orderly manner.

Analyzes Upgrading System

To consider first the Industry upgrading system, this is the concept on which it works: A certain man's job is a composite of many operations. Most of these operations, taken singly, are simple enough for low-skilled men to do. Therefore, if the job is analyzed into its parts, the intricate parts can be retained by the skilled man who has been doing the whole job, and the simple parts turned over to men in the upgrade process. This may take away from the skilled man as much as 70 or 80 per cent of the operations, saving an equivalent percentage of his time. The trainees graduate through the whole job, eventually becoming as good as the original skilled man.

For example, the making of range-finding instruments in Army arsenals was found to include some 400 operations, most of which could be done by men without all-around skill. Washington training executives say that the machine tool industry is foremost in adopting the upgrade system.

The White Sewing Machine Co., Cleveland, is one of the many metal-working firms that are coordinating their upgrading with the Training Within Industry program. Oscar Grothe, vice-president of the firm, is in charge. He said that 90 per cent of training must be done by industry; the educational and vocational institutions will be able to handle only 10 per cent.

Training Within Industry is being organized on a national basis, with more than 20 regional offices, soon to be announced. Defense Commission men, borrowed from industry, will be managers. Each will have four advisers, two from industry and one each from CIO and AFL. In addition, a panel of industry advisers is being built up for each office

Now turning to the Labor Supply and Training section, or pre-job training, its seven coordinated agencies are functioning, in brief, as follows:

Public employment Service, a branch of Social Security, has about 1,500 full-time and 3,000 part-time local employment offices throughout the country. Analyzes qualifications of workers, refers each worker to the proper training group; contacts 20,000 defense employers; keeps track of the labor market in 500 basic occupations essential to defense.

United States Office of Education, has a program of vocational defense training in all states except Nevada for unemployed workers, and for employed workers to be upgraded. Short engineering courses are provided in 92 colleges with an enrollment of 36,500 anticipated. Out-of-school vocational training is provided in 31 states. Courses are given to workers on National Youth Administration projects. Total appropriations by last Congress for USOE were about $75,000,000.

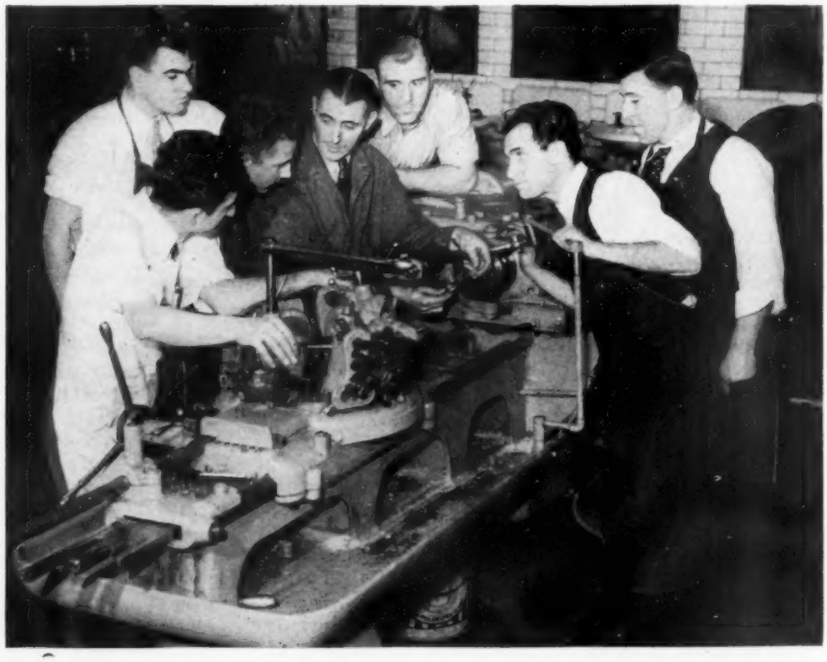
Works Project Administration is training more than 50,000 enrollees, who receive regular pay. Also, it is sponsoring the training of about 6,000 needy persons as airport servicemen, for commercial and military aviation. WPA appropriations and allocations for vocational training total about $36,000,000, including $7,500,000 from Office of Education.

The Civil Service Commission recruits labor for the Army arsenals and Navy establishments. Up to the first of the year it had placed over 200,000. Age maximum has been reduced from 48 to 62, and other requirements have been relaxed.

Federal Committee on Apprenticeship has expanded its service with current appropriations totaling $345,000.

National Youth Administration, with an appropriation of $30,000,000, up to December 28 1940, was employing and training 366,000 persons age 17 to 24. One Thousand rural vocational training centers are being constructed.

Civilian Conservation Corps has enrolled at this time 300,000 young men who are acquiring improved work habits and non-combat skills.



Trained Labor For Defense—*Everywhere in the U. S. manufacturers are looking for "trained labor," labor which can do their job. To provide the trained labor necessary to speed production in U. S. defense industries public and private agencies are lending their unstinted aid. Congress has appropriated $9,000,000 to train over 30,000 students at 92 engineering colleges in 44 states, the District of Columbia, and Puerto Rico. In New York City, WPA men who have had some technical experience are enrolled in the "grave yard shift"; classes are held from 10:30 p.m. to 5 a.m. At Jersey City's Dickinson High School (above) training classes for machine operators run 22 hours a day. Expert craftsmen from Westinghouse Electric Co. assist in training over 450 men at a time*

Labor Training Programs Waste Time, Reports ASTE; Proposes Organized Direction

DETROIT—Too much time is being wasted in many communities in setting up the proper educational facilities for the training of skilled men to meet the existing shortages in defense industries, indicates the American Society of Tool Engineers in a report on "Emergency Education and Training for the Metal-Working Industry". This is largely due to the fact, continues the report, that no one group has any authority and insufficient cooperation exists between industry, labor, schools and governmental bodies created to set up the needed facilities.

The Society, which submitted its findings after a thorough investigation covering the training programs in use by industrial concerns, vocational schools, and others instituted through state or federal action, indicates that the training of men to meet existing shortages, falls in two classifications: 1. Training men with no experience, 2. training men already in industry, or upgrading.

Localized Direction Needed

The training of men for occupations requiring the least skill can be performed most effectively under localized direction. This is due in part to the tremendous diversification of industrial occupations at the base of the industrial ladder, and to the great differences existing in local requirements as to occupation.

Upgrading education of men in industry is again a problem requiring localized direction. In an emergency training program, all such education must be designed to meet specific needs if time, effort and money is not to be wasted.

The already existing shortage, which promises to reach a new peak next Spring, has already resulted in, and bids fair to aggravate, the raiding and cross-raiding by industrial concerns of each others' trained personnel. The result will be an increase of labor costs and a reduction in operating efficiency.

Each industrial community needs a group of men to act as an administrative force. In this group, industry, government and educational facilities must have a voice. To achieve the needed cooperation between industry, labor, government and education, a national chain of local coordinating committees, acting in a purely advisory manner, should be set up. In this work, the ASTE can be a major service to hundreds of industrial communities.

A national advisory committee should also be organized to provide a needed interchange of information between the various local committees and assist them in increasing the effectiveness of their activities. To prevent delays the seriousness of the situation should be brought home to the population in each industrial community.

Prior to embarking on an upgrading education program, the ASTE recommends that each plant make an immediate study of all employees with a view to selecting those suited for occupations requiring higher degrees of skill. In many cases only a little training has been found necessary to adopt a trained and capable machine operator to jobs requiring the abilities of a skilled mechanic. A really skilled mechanic can be converted quickly into a tool and die maker, and an ambitious tool and die maker can be trained without difficulty to handle simple tool and die or fixture designs.

A previous survey completed by the ASTE showed a shortage of 110,000 tool engineers, 310,000 tool and die makers and 740,000 skilled mechanics, a total in excess of 1¼ million men.

USED TOOL PRICES SOAR

WASHINGTON—The price of second-hand machine tools, some of them as much as 20 years old, has advanced 30, 40, 50 and even 100 per cent in recent months, say Defense Commission officials, and they are deeply concerned. It is reported that Army and Navy officers have already threatened a move to have the government take over the re-allocation of used tools.

More and more old equipment will have to be put to work in defense production, and shops that are not using all their tools are being urged to give them up, especially the heavier units. Some shops can speed the tools up where they are; others cannot. The public interest demands that a way be found to utilize this equipment and it is felt that price speculation on this situation cannot be permitted. At a recent meeting in Washington second hand dealers promised their cooperation to keep prices down.

Machine tool manufacturers continue to meet with the Defense Commission every couple of weeks.

Future Labor Peace Is Laden With Danger Although Strikes Decreased In 1940

NEW YORK—The meshing gears of increased production for defense have their reverberations around the conference table where labor and management representatives are spending more time than ever before. Labor union demands for a greater share of income keep pace with mounting business.

Already four major industries—shipping, steel, auto, and electrical manufacturing—are faced with determined requests for substantial wage boosts. A fifth—coal—will meet comparable union demands when wage conferences begin March 11. By spring a concerted drive for higher pay rates will be under way in every industry where unionism has a foothold.

Although there are many labor disputes, each receiving wide publicity because of the defense program, there has been an actual dropping off in the number of strikes and a smaller number of man-days lost due to striking. Official government figures reveal that 1940 saw 160 fewer strikes than 1939, and that only a third as much idleness resulted. The trend continues into 1941.

While most current union palaver is concerned with wages and is resolved peacefully, there is no real assurance that this will continue to be the case. Danger spots are latent in the fact that the defense industries are only 30 to 40 per cent unionized with aggressive organizing campaigns under way or projected in most fields. In determined drives for recognition and bargaining rights, the kind of compromising which settles wage demands is not very effective.

Whetting the union appetite for recognition, already heightened by industrial expansion, are the dicta laid down by the U.S. Supreme Court in its recent decision in the Heinz case. In this decision, hailed as its most important labor ruling since it validated the Wagner Act in 1937, the Court upheld a National Labor Relations Board order against Heinz in which it was held that if a company made an agreement with a labor organization and refused to set it down in writing and sign it, the company was refusing to engage in collective bargaining and was thus violating the law.

The practical implications of this decision mean that wherever a union can get a company to recognize it, and come to some agreement, it will be rewarded with a written contract; patently, a tremendous stimulus to organization.

Hence, even though the cost of living does not spiral upward evoking further and more drastic wage demands, the future for labor peace is fraught with danger. Whether repressive labor legislation, designed to curb striking, has a chance of enactment depends largely on how many disputes get out of hand. Union leaders can be counted on to do a lot of trimming in their demands before taking steps which will set up a public clamor for restrictive laws. How well they can gage the tolerance of public opinion is the key to the labor outlook for the next quarter.

U. S. Lend-Lease Bill Changes Canada's War Production Plans; Priorities Revised

MONTREAL—All-out U.S. aid to Britain, exemplified by the Lend-Lease bill, has caused Canada to change some of its war production plans. The change is one of emphasis, of priorities.

Production of motorized equipment, and boatbuilding, including the construction of merchant ships, will be increased. Canadian motor plants have already been expanded considerably. Workers have been diverted to military vehicles from civilian production.

Priority will be given to the construction of merchant ships at the largest shipyards. Work has already started. Initial orders have been given for 18 cargo ships to cost $50,000,000. The ships will be 416 ft. long, have a 56 ft. beam and draw 25 ft. of water, have a deadweight capacity of 9,300-tons. Canadian Vickers, Ltd., Montreal; Davie Shipbuilding & Repair Co., Lauzon, Que.; and Burrard Dry Dock Co., Ltd., Vancouver, will each build six ships of this type.

Increased attention has followed a drastic shake-up of the Canadian aircraft industry. Emphasis is on rapid construction of planes. For example, construction of Avro-Anson bombers has been lagging four months behind schedule. In part, this has been due to the conflict raging between the management of the $50,000,000 government-owned company (Federal Aircraft, Ltd.) which was set up to arrange for the production of Ansons, and various aircraft companies which were to handle the production of parts.

The jam has been broken and the government is using new powers to assure the use of full facilities for aircraft output. The week ending January 17 saw contracts valued at $51,893,003 let for production of planes with various companies. National Steel Corp. received an order totaling $1,890,000 for aircraft.

At the end of 1940 contracts for war materials and for plant construction let by the Canadian Department of Munitions and Supply in behalf of the Canadian and British governments totaled $1,105,832,939. On Canadian account, contracts of $671,558,791 were placed.

War plants are to be given priority over the armed forces in drawing manpower. This policy also extends to farm work where farm boys are to be given "every benefit of the doubt" when applying for postponement of military training.

The government's training program to provide skilled workers will be counted on to supply 100,000 men during 1941. But a serious shortage exists as 200,000 are needed for war plants and for technical duties in the military service.

Export of Machinery During November, 1940

	November 1940	October 1940	November 1939
Electrical machinery and apparatus	$10,571,762	$10,494,951	$9,761,135
Power-generating machinery, except electric and automotive	2,054,421	1,895,921	1,245,141
Construction and conveying machinery	2,974,860	2,750,359	1,464,916
Mining, well, and pumping machinery	3,758,680	3,491,008	3,793,296
Power-driven metal-working machinery	27,413,932	26,798,995	8,604,263
Other metal-working machinery	911,038	811,255	446,237
Textile machinery	690,189	1,219,550	825,572

Metal-Working Machinery

Engine lathes	$2,173,214	$1,755,049	$614,858
Turret lathes	1,765,503	2,164,490	487,714
Other lathes	1,952,385	3,027,585	319,878
Vertical boring mills and chucking machines	1,050,307	810,944	477,673
Thread-cutting and automatic screw machines	2,005,015	2,976,694	434,957
Knee and column type milling machines	2,742,799	1,509,884	518,304
Other milling machines	3,310,786	3,407,275	843,427
Gear-cutting machines	466,281	640,646	468,851
Vertical drilling machines	436,143	312,373	239,293
Radial drilling machines	271,162	460,875	68,922
Other drilling machines	949,514	556,548	95,661
Planers and shapers	569,335	589,046	203,111
Surface grinding machines	434,342	882,574	174,414
External cylindrical grinding machines	579,676	659,388	602,592
Internal grinding machines	354,789	603,766	460,276
Tool grinding, cutter grinding, and universal grinding machines	1,197,733	886,130	489,133
Other metal-grinding machines and parts	1,376,574	1,607,447	361,810
Sheet and plate metal-working machines and parts	637,181	652,374	348,624
Forging machinery and parts	757,854	422,102	351,887
Rolling-mill machinery and parts	1,653,819	368,777	161,368
Molding machines	15,114	23,764	27,230
Other foundry equipment and parts	163,481	201,671	130,040
Other power-driven metal-working machinery and parts	2,542,871	2,263,128	724,076
Pneumatic portable tools	93,175	110,875	107,594
Other portable and hand or foot-operated metal-working machines and parts	161,117	208,359	84,714
Chucks for machine tools	50,649	73,852	30,127
Milling cutters, machine-operated threading dies and taps, and similar machine-operated metal cutting tools	260,451	136,849	114,895
Other metal-working machine tools and parts	345,646	281,320	108,907

New Studebaker and Buick Plants in Chicago Area

CHICAGO—The Studebaker plant to be built for the manufacture of precision parts for Wright engines will be located in Chicago near the airport, and the $31,000,000 aircraft engine plant to be built by Buick will be located in Melrose Park, a suburb of Chicago. When the National Defense Advisory Commission approved a $4,000,000 contract by which Stewart-Warner will produce machinery and equipment for ordnance items, and a $5,550,000 order to Elgin National Watch Co. for artillery fuses, Chicago received another large share of national defense business.

The Buick plant will employ about 10,000 men and increase Chicago's annual payroll by approximately $17,000,000. The expansion will add more than 1,000,000 sq.ft. to the company's plants and will have a capacity to produce 500 Pratt & Whitney 1,200 hp. engines per month. Through the co-operation of educational institutions Buick is considering an apprentice training system for boys in the Chicago area.

The Studebaker plant will consist of an air-conditioned plant of about 600,000 sq.ft. Studebaker is also building plants at South Bend and at Fort Wayne, Ind. The combined cost of buildings and equipment will be near $49,700,000. Final assembly of the engines will be at South Bend.

Stewart-Warner will spend $1,000,000 for new equipment to produce the $10,000,000 defense contracts.

Industrial Machinery Soars to Export Record

WASHINGTON—United States' exports of industrial machinery in November established a new record for the second successive month with total shipments amounting to $45,251,696, compared with $43,567,434 in October, 1940, as reported by the Machinery Div., U.S. Department of Commerce. Machine tools exports to England amounted to $19,218,029, or slightly below the October value of $19,902,633. November shipments to England accounted for 77 per cent of total machine tool exports.

Valued at $27,413,932, November exports of power-driven metal-working machinery reached a new high, 2 per cent above shipments in October, 1940. Shipments of milling machines rose to $6,053,585 from $4,917,159 in the previous month and exports of drilling machines were up to $1,656,819 from $1,329,796.

BUILD WAYS ON WEST COAST

LOS ANGELES—California Shipbuilding Co., a concern recently formed, is building eight shipbuilding ways at a cost of $5,000,000. The company will build ships for the U. S. Maritime Commission.

INSIDE DETROIT

Defense Committee being set up by Automotive Tool & Die Manufacturers Association. Car and truck production soared to a new record in January; the outlook for 1941 continues promising

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Profiting by the experience of the machine-tool industry, the Automotive Tool & Die Mfgrs. Association is setting up a Defense Committee, which shall have the following functions: (1) maintain a continuous survey of idle capacity in cooperating shops, both members and non-members, and (2) from a study of the requirements of national defense contractors, determine which facilities are in the best position to provide prompt service. It is hoped that shops in Cleveland, Dayton and Milwaukee will either set up similar plans or cooperate with the Detroit group, which has offices at 15 Boulevard Bldg.

National defense contractors wishing to use the services of the independent tool and die shops in these areas will save time by laying their problems before such a Committee. Personnel of the Committee will be experienced in all phases of tool and die work, and will have at their disposal up-to-the-minute information concerning which shops can handle given contracts quickly and satisfactorily. First step in the prospective program is to make a survey of all the equipment installed in jobbing shops by kind and capacity and with due regard to the specialized skills of management and men employed. With this information cataloged, plus the periodic idle-capacity report, the Committee can quickly point to the plants best able to undertake a particular project at the time.

Time Can Be Saved

By utilizing the services of the Committee, national defense contractors will also save the time of job-shop proprietors. This is in itself an important factor, because as much as 90 per cent of the blueprints and specifications being dumped in the laps of some job-shop owners are unsuitable for the equipment and skill of that particular enterprise. If the time of these men can be saved through proper allocation of work, the national defense effort of the industry will be speeded commensurately.

Passenger car and truck production soared to a new record for the month of January, having equaled or surpassed 500,000 units in the U.S. and Canada. The outlook continues promising. February assembly schedules will be stabilized by volume producers, followed by a seasonal rise in March, April and May. Commitments for steel have been made through May by certain interests for consumption at a higher rate than currently prevailing. Pressure is being brought on steel vendors to assure shipments on time. In general, auto companies expect to attain original objectives for the 1941 model year, and even to surpass them in some instances.

The underlying situation continues healthy. Despite the unprecedented assembly pace in the past four months, field stocks of new cars have not equalled mid-winter peaks of former years. On January 1 field stocks were placed at 400,000 units by reliable sources. Due to the exceptional retail demand in January, field stocks have not increased more than 60,000-75,000 units during the past 30 days.

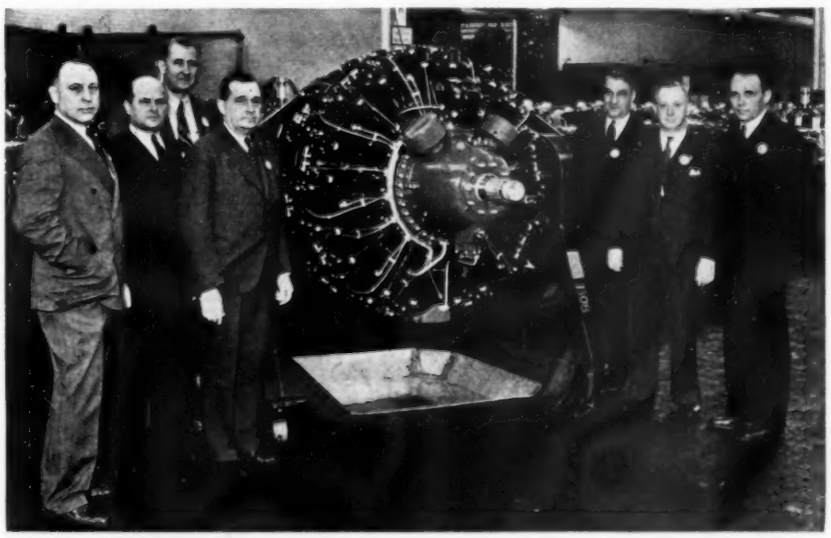
Turning to actual sales records, Chevrolet broke previous records for the first and seecond ten-day sales periods of January. Sales of passenger cars and commercial cars by this G.M. division totalled 58,978, a 24.4 per cent advance over the same period of 1940. Used-car sales were 23 per cent ahead in the twenty-day period. Buick set a new record for the second ten-day period, disposing of 7,341 new cars. Both unfilled orders and new orders went up during the second ten days of January, new retail orders rising 56 per cent over a year ago.

General Motors Divisions are offering, or will shortly announce, midseason models with a new smaller body styled after the custom trunk-back Torpedo. Buick and Pontiac showed their new lines in January; Oldsmobile will probably follow Pontiac's example soon; and Chevrolet holds back until next month. Known as the Series 40 (A) Specials, four models have been added to the regular Buick Series 40 Special line. In effect, the Flint manufacturer now has six lines of cars. Pontiac later introduced a single new model, the Metropolitan Torpedo four-door, four-window sedan on the 119 in. wheelbase chassis, and with an option of six- or eight-cylinder engine.

Buick officials admitted at the preview for the new mid-season models

PREDICT PRICE RISE

DETROIT—Higher labor costs in the steel industry is a strong possibility. If wages advance ten per cent steel vendors predict that automotive material must advance $4 to $5 per ton and that the increase in cost must be passed on to the automobile factory. The recent wave of wage increases won by labor in automotive and parts plants, plus a rise in steel prices this spring will doubtless force car manufacturers to advance prices.



The 25,000th Engine—*Manufactured by the Pratt & Whitney Div., United Aircraft Corp., rolled off the assembly line January 23. Eugene Wilson, president, United Aircraft; and members of the Pratt & Whitney Div., A. V. D. Willgoos, chief engineer; W. A. Parkins, assistant chief engineer; W. Levack, assistant superintendent of assembly; G. H. D. Miller, factory manager; D. Jack, assistant factory manager; and L. S. Hobbs, engineering manager, were on hand for the occasion. The engine was shipped to the U. S. Air Corps*

Buick Shuffles Key Men to Aid Aircraft Engine Production

D. E. WILLIAMS

J. G. HAMMOND

R. H. ARCHER

W. N. LARKE

BYRON H. NEWELL

that the die program for the 1942 models will be extensive, that work is well advanced upon the new tools. While other manufacturers are also planning sheet-metal changes that will not interfere with the national defense program, only a few die castings have been made so far, and only approximately 25 per cent of the local diemakers are currently employed at their regular trade. Normally there are between 5000-6000 men to draw upon. Job shops report that they are getting plenty of men as needed, and that their regular employees are returning rather than to give up several years of seniority.

The current die season is about two months ahead of last year. While there have been reports that it will be wound up by April, much depends upon the amount of national defense work that can be assigned to the die shops this spring. So far their facilities have not been found suitable, but it is possible that large jigs and machine elements may be farmed out to them. Naturally, such work will get the priority over the automotive program. In any event, the auto companies are playing safe, and they will be able to release further talent to national defense purposes when that is made necessary.

An early die program does not mean at this stage that the model changeover will be many weeks earlier this year. From what is known about the plans of several manufacturers in respect to remaining 1941 production, it is believed that the usual early birds will not beat last year's changeover by more than a couple of weeks.

Westinghouse Will Treble Defense Production for 1941

EAST PITTSBURGH — Westinghouse Electric & Mfg. Co. will expand its defense production threefold in 1941. The company, which produced $18,000,000 worth of national defense materials in 1940, has a backlog of orders totaling more than $140,000,000 for defense material at present. Delivery of the first completely assembled gun mount produced for the Navy will be made next month. This is part of an order for 400 gun mounts received last August. The remaining units will be delivered at the rate of 40 a month after the initial shipment.

Buick Sets Up Separate Organization for Aircraft

DETROIT—Buick has set up a separate organization for production of aircraft engines under the national defense program and made extensive rearrangements in personnel of the motor-car division. More than 40 key production and engineering technicians and members of the management staff are affected by shifts and promotions to fill vacancies. Key figures on the staffs and their former responsibilities in the Buick Motor Division are:

Aircraft-Engine Division:

D. E. Williams, operating manager, formerly comptroller; J. G. Hammond, general manufacturing manager, previouosly general superintendent; I. H. Larkin, assistant manufacturing manager, formerly superintendent of tool manufacture; R. H. Archer, general superintendent, formerly chief of standards; and James O'Neil, assistant general superintendent, previously assistant superintendent of the gear and axle plant.

C. N. Ofield, chief inspector, formerly same position on motor-car division staff. H. E. Hardenbrook, works engineer, formerly assistant works engineer of Buick; R. E. Mitchell, master mechanic, formerly assistant master mechanic; A G. MacDougall, assistant master mechanic, formerly on Buick master mechanic's staff; and L. A. Stewart, purchasing agent for both divisions.

Motor-Division Promotions:

Walter N. Larke, general superintendent, promoted from assistant; B. H. Newell, assistant general superintendent, previously foundry superintendent; John F. Kennedy, chief of standards, formerly assistant; Albert R. Bender, chief inspector, formerly assistant; Fred W. Moore, superintendent of tool manufacture; and Homer Schultz, assistant master mechanic.

The aircraft division will be under direct Buick control.

SUB-CONTRACT WORK DONE

SYRACUSE, N. Y.—The Aircraft & Arms Procurement Co., Syracuse, representing more than 200 plants from coast to coast, is playing a unique role in the defense program. The organization, born at the very beginning of the defense program, acts as a clearance house for companies desiring to sub-contract aircraft and armament work. Some of the plants associated with this organization are nationally known manufacturers who have available capacities to handle additional sub-contract work. A catalogue of the plant facilities with a keyed index is available if requested from the Syracuse office of the company. The work of the organization is bringing together manufacturers having defense contracts and machine shops with open capacity for sub-contracting.

WATCHING WASHINGTON

Administration's power is irresistible as defense bills pass easily. Only delay is on "lend-lease" measure. U. S. shipbuilding hits new high. CIO would organize steel into "one great production unit"

By BLAINE STUBBLEFIELD

WASHINGTON—A great deal of important legislation, of interest to the metal-working industries, is now on its way through Congress to the White House. The Administration's power is irresistible; there is no delay except on the Aid-to-Britain measure:

House hearings on the British Aid bill have closed, Senate hearings have started, and may end as you read this. Senate debate will go on for weeks. Nothing new is being, or will be, said. Political strategy, not argument, is the driving power. Democrats landed a punch when the House Foreign Affairs Committee voted to hear Army, Navy, and Air heads in secret session. Republicans charged that the truth these three might tell about American isolation security would hurt FDR's belligerent program.

The happiest warrior for Britain and Roosevelt now is Wendell Willkie, whose trip to England is timed for maximum damage to Republican-isolation aims. The battle can bring to FDR's opposition only a time limit on his power, which otherwise would be hard to repeal if emergency should end during his term. It can easily be renewed if emergency outlasts the Act.

A bill being introduced to raise the debt limit from $45,000,000,000 to $65,000,000,000 will be enacted as a mere formality. There is not, and never was, any such thing as a debt limit. Any Congress, responding to public willingness to assume debt, can brush the figure out with one swipe of the eraser and write up a bigger one. Important, though, is the inclusion in this bill of a proposal to tax the income from federal securities. This will soak the rich by stopping their tax-free investments; it will divert money to free enterprise, which will please business; small investors in federal securities won't mind, because their share of the tax will be minute. Of course the law cannot be retroactive; federal bonds outstanding will be bid up. But the Administration expects that more private money will start to flow into production, which is especially desirable for defense just now. On the heels of federal security taxes will come a battle over taxes on state and local bonds.

Also passed by the House and approved by Senate Naval Affairs is an authorization to (1) spend $400,000,000 for 400 torpedo motor boats, mine sweepers, sub-chasers; 280 most urgently needed to be built this year; (2) spend $315,000,000 for additional shipyards and facilities for these small craft and for regular two-ocean construction program; (3) spend $194,000,000 on plant expansion to produce parts for cargo ships, guns, and armor.

The House and Senate passed an authorization of $300,000,000 for anti-aircraft defense of the Navy: additional anti-aircraft guns; replacement of old anti-aircraft guns; pom-poms (repeating anti-aircraft) steel shelters for crews at battle stations; increased magazine capacity and ammunition handling equipment. The anti-aircraft protection will go on 161 older ships; take three-four years because ships must stay on the job until other repairs are needed.

Appropriation of $350,000,000 to build 200 steel cargo ships for operation by the Maritime Commission passed the House, undoubtedly on its way to enactment. About $40,000,000 of this is for increase of shipbuilding facilities and administration. No authorization was needed; the Maritime Commission already has that. The bill provides that no members of "subversive organizations" may be employed.

U. S. Shipbuilding Hits Record

U. S. shipbuilding program now exceeds that of the World War and sets a world record. Since June 1 contracts have been awarded, or force-account work started, on about 643 Naval and Maritime Commission ships at a cost of $4,079,000,000. In addition, work is in progress on $670,000,000 worth of vessels laid down before that date. Between now and June 1942, 253,400 additional workers must be employed. About 8,100 more men will be added between June and November 1942 when the program will reach its peak. Of the total 388,000 at that time, 126,000 must be skilled; among them 31,000 machinists; 11,000 shipfitters; 9,000 sheetmetal workers, 12,000 welders. About 250,000 additional men will be required in mines, transportation, factories, to service the shipbuilding. This data is from a survey by A. F. Hinrichs, Acting Commissioner of Labor Statistics, who is conducting defense labor studies.

CIO on Steel Production

CIO further confused the controversy over steel productive capacity and estimated requirements by calling for organization into "one great production unit." CIO maintains that output is falling 5,920,195 net tons below attainable production. Other avenues report that the industry is operating at 99% ingot capacity. Critics in Washington say the CIO is "pulling another Reuther (500-planes-a-day) plan"; that similar tactics have been used on housing. The observers allege that CIO is trying to appear constructive to cover any appearance of being predatory in the defense rush; that it is making ready to take over, if business management fails. On the other hand, some sources credit Mr. Murray with a sincere effort to help with defense. Others say he is trying to aid the small steel firms in getting government business. Meanwhile, anonymous "defense executives" continue to press for 10% increased capacity, while steel firms insist there will be no shortage. Probably there will be no decisive position until Knudsen receives the report for which he has called and comes to his conclusion.

Survey Needs for Skilled Labor

A series of surveys regarding the skills employed and required in critical industries is being made by the Bureau of Labor Statistics, U. S. Department of Labor. Reports have already been made on aircraft and shipbuilding. Now in process, to be completed in about three weeks, is a study on the ordnance industries. This is being done in parts: small arms, machine guns, large guns, ammunition; it is difficult because recorded experience, such as that available in other lines, is lacking. A survey probably will be made on tank production.

PLANE PRODUCTION RISES

WASHINGTON—Exact production figures on armament are military secrets, but every so often a few slip out. Here are some of the latest: Airplane production, which exceeded expectation with an output of 799 units in December, is running about 900 (having got back to the level of last August) and consists of about 540 trainers and 360 combat planes, most of which are going abroad.

Light (13-ton) tank production is five months ahead of schedule. It is running at about a four-a-day rate except that there was a model-change shut-down of about a month around the first of the year. The 26-ton medium tanks are not yet in production and will not be until Chrysler's tank arsenal comes into production in the fall.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $100,000)

Source	Agency	Commodity	Amount
Willamette Iron and Steel Corp., Portland, Ore.	Navy	Minelayers	$1,000,000
Associated Shipbuilders, Seattle, Washington	Navy	Seaplane tenders	700,000
Ingalls Shipbuilding Co., Pascagoula, Miss.	Navy	Net layers	2,000,000
Sun Shipbuilding Co., Chester, Pa.	Navy	Destroyer and Seaplane tenders	2,500,000
Los Angeles Shipbuilding & Dry Dock Co., San Pedro, Calif.	Navy	Repair ships	400,000
Struthers Wells-Titusville Corp., Titusville, Pa.	War	Forgings	238,306
Babcock & Wilcox Co., New York, N. Y.	Navy	Boilers	181,349
Budd Wheel Co., Detroit, Mich.	War	Shell	5,416,680
National Supply Co., Ambridge, Pa.	War	Forging	1,221,500
Westinghouse Airbrake Co., Wilmerding, Pa.	War	Booster parts	416,355
Landis Machine Co., St. Louis, Mo.	War	Fuse parts	777,690
Bullard Co., Bridgeport, Conn.	War	Boring mills	299,815
Motch & Merryweather Machinery Co., Cleveland, Ohio	War	Grinders	107,833
Waco Aircraft Co., Troy, Ohio	CAA	Trainers	286,790
Curtiss-Wright Corp., Curtiss Aeroplane Div., Buffalo, N. Y.	War	Airplanes	19,688,287
Cessna Aircraft Co., Wichita, Kansas	War	Airplanes	900,378
Fruehauf Trailer Co., Detroit, Mich.	War	Semi-trailer	1,115,096
American Locomotive Co., Schenectady, N. Y.	War	Locomotives	121,600
Cambridge Instrument Co., Inc., New York, N. Y.	War	Indicator	194,480
Charles Engelhard, Inc., Newark, N. J.	War	Indicator assys.	180,905
Sheffield Gage Corp., Dayton, Ohio	War	Gages	910,000
Nicholson File Co., Providence, R. I.	Navy	Files	169,532
Pressed Steel Tank Co., West Allis, Wis.	Navy	Cases	150,366
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.	War	Pistols	1,014,869
Milwaukee Stamping Co., Milwaukee, Wis.	War	Container assys.	356,360
Federal Screw Works, Chelsea, Mich.	War	Booster	2,298,000
Bohn Aluminum & Brass Corp., Detroit, Mich.	War	Brass forgings	117,685
Emerson Elec. Mfg. Co., St. Louis, Mo.	War	Boosters	822,232
National Pneumatic Co., Rahway, N. J.	War	Booster parts	783,080
Robertshaw Thermostat Co., Youngwood, Pa.	War	Booster parts	1,493,100
Kearney & Trecker Corp., Milwaukee, Wis.	Navy	Milling machines	455,970
Van Norman Machine Tool Co., Springfield, Mass.	War	Milling machines	256,003
General Mach. Corp., Hamilton, Ohio	Navy	Engine lathes	130,260
Consolidated Mach. Tool Corp., Rochester, N. Y.	Navy	Boring mill	215,600
Giddings & Lewis Mach. Tool Co., Fond du Lac, Wis.	Navy	Boring machines	139,208
E. A. Kensey Co., Cincinnati, Ohio	War	Lathes	190,524
International Harvester Co., Springfield, Ohio.	Navy	Trucks	258,882
General Electric Co., West Lynn, Mass.	War	Generator assys.	1,138,170
Timken Detroit Axle Co., Detroit, Mich.	War	Adapter	120,131
Edgewater Steel Co., Verona, Pa.	War	Adapter assys.	193,106
Buda Co., Harvey, Ill.	War	Diesel engines	3,891,705
Seabrook Yacht Corp., Seabrook, Texas	Navy	Boats	126,724
North American Aviation Inc., Inglewood, Calif.	War	Airplanes	72,857,049
North American Aviation of Texas, Inc., Dallas, Texas	War	Airplanes	37,770,981
General Electric Co., Schenectady, N. Y.	Navy	Locomotives	128,425
Bendix Aviation Corp., Pioneer Instrument Div., Bendix, N. J.	War	Indicators	6,393,220
Bendix Aviation Corp., Pioneer Instrument Div., Bendix, N. J.	War	Assemblies	308,000
Boeing Aircraft Co., Seattle, Washington	War	Fuel tanks	249,015
C. H. Gosiger Mach. Co., Dayton, Ohio	War	Lathes	240,109
Bradford Mach. Tool Co., Cincinnati, Ohio	War	Lathes	241,735
Service Tool & Engineering Co., Dayton, Ohio.	War	Sight assemblies	154,000
Webster Electric Co., Racine, Wis.	War	Solenoid assemblies	116,298
Bell Aircraft Corp., Buffalo, N. Y.	War	Adapters	229,245
American Gas Accumulator Co., Elizabeth, N. J.	War	Trucks	153,948
R.C.A. Mfg. Co., Inc., Camden, N. J.	War	Radio receivers	264,341
Babcock & Wilcox Co., New York, N. Y.	Navy	Boilers	181,349
Robertshaw Thermostat Co., Youngwood, Pa.	War	Booster parts	270,249
Norris Stamping & Mfg. Co., Los Angeles, Calif.	War	Band assemblies	187,842
Rheem Mfg. Co., Chicago, Ill.	War	Fin assemblies	326,541
American Car & Foundry Co., Buffalo, N. Y.	War	Forgings	6,040,000
The McKay Co., York, Pa.	War	Tow chains	219,324
Anaconda Copper Mining Co., Black Eagle, Mont.	War	Fuse parts	110,037
Thomas P. Gibbs & Co., Delevan, Wis.	War	Turning machines	300,000
General Railway Signal Co., Rochester, N. Y.	War	Machining	4,375,000
R. Hoe & Co., Inc., New York, N. Y.	War	Recoil mechanism	3,014,750
R. K. Le Blond Machine Tool Co., Cincinnati, Ohio	War	Lathes	301,173
Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford, Conn.	War	Lathes	204,950
Cincinnati Shaper Co., Cincinnati, Ohio.	War	Shapers	202,978
Otis Elevator Co., New York, N. Y.	War	Recoil mechanisms	2,722,679
General Electric Co., Schenectady, N. Y.	War	Radio trans.	6,460,325
Bendix Radio Corp., Baltimore, Md.	War	Radio equip	1,834,436
R.C.A. Mfg. Co., Inc., Indianapolis, Ind.	War	Sound equipment	176,264
R.C.A. Mfg. Co., Inc., Camden, N. J.	War	Radio receivers	2,119,739
Hudson & Terraplane Sales Corp., Detroit, Mich.	Justice	Sedans	137,744
Federal Motor Truck Co., Detroit, Mich.	War	Truck-tractors	584,750
Bendix Aviation Corp., Bendix Products Div., South Bend, Ind.	War	Turrets	12,671,030
Le Roi Company, Milwaukee, Wis.	War	Field trucks	153,948
Mergenthaler Linotype Co., Brooklyn, N. Y.	War	Telescopes	611,431
H. Cole Co., Columbus, Ohio	War	Compasses	112,000
Fairchild Aviation Corp., Jamaica, N. Y.	War	Instruments	291,591
Revere Copper & Brass Inc., Baltimore, Md.	War	Rotating copper bands	342,677
E. Bers and Co., Philadelphia, Pa.	War	Ammunition components	125,200
Wycoffk Drawn Steel Co., Ambridge, Pa.	War	Steel	115,460
Hayes Industries, Inc., Jackson, Mich.	War	Wheel and brake assem's	471,395
Bendix Aviation Corp., Bendix Products Div., South Bend, Ind.	War	" " "	260,100
Lyon Metal Products, Inc., Aurora, Ill.	War	Metal trucks	458,965
Greenport Basin & Construction Co., Greenport, N. Y.	Navy	Mine sweepers	631,400
Herreshoff Mfg. Co., Bristol, R. I.	Navy	" "	304,000
General Electric Co., Erie, Penna.	War	Locomotives	135,225
General Electric Co., Schenectady, N. Y.	War	Radio transmitters	241,475
Kilby Steel Co., Anniston, Ala.	Navy	Cutters, spike and star.	167,193
Thorrez and Maes Mfg. Co., Jackson, Mich.	Navy	Steel bodies	216,383
National Cash Register Co., Dayton, Ohio	War	Artillery Ammunition	174,000
Bendix Aviation Corp., Eclipse Machine Div., Elmira, N. Y.	War	" "	148,824

NAMES in the NEWS

Louis R. Botsai has been appointed manager, Gearing Department, Westinghouse Electric & Mfg. Co. For the past three years Mr. Botsai has been sales manager of the company's Small Motor Div., Lima, Ohio.

H. L. Charlton, vice-president, Reynolds Metal Co., Richmond, Va., will be in charge of erection and purchases at the new $23,500,000 aluminum plant now under construction at Sheffield, Ala. Basil Horsfield will be manager of the plant; R. S. Sherwin will be consulting engineer, and B. L. Baxter, chief electrical engineer.

Bonnell W. Clark, R. A. McCarty, Frank D. Newbury, and A. C. Streamer, all of whom were district managers, Westinghouse Electric & Mfg. Co., have been named vice presidents.

James K. Fulks and M. B. Montgomery have been appointed factory manager and superintendent, respectively, Ex-Cell-O Corp.

George W. Frick has been named manager, Firthite Div., Firth-Sterling Steel Co., McKeesport, Pa.

Rudolph F. Gagg, formerly assistant chief engineer, Wright Aeronautical Corporation, has been appointed assistant to the general manager. He will work on special projects. Mr. Gagg joined the organization as an experimental engineer in 1930.

Robert G. Glass has been appointed assistant manager of operations, Chicago district, Carnegie-Illinois Steel Corp.

George D. Keller, vice-president in charge of sales, Studebaker Corp., has been appointed assistant to H. S. Vance, chairman, who is directing Studebaker's defense manufacturing program. K. B. Elliott, vice-president, has been named to succeed Mr. Keller as vice-president in charge of sales.

Dr. Ernest M. Hopkins, president, Dartmouth College, has been appointed executive officer of the new minerals and metals priority section of the Division of Priorities, Office of Production Management. Mr. Hopkins will also serve as chairman of various industrial committees, including an Iron and Steel Priorities Committee.

James F. Towers, executive vice-president, Ford, Bacon & Davis, Inc., New York, N. Y., industrial engineers, has been appointed assistant director in charge of administration.

E. S. Chapman, who has been vice-president and assistant general manager of Chrysler's Plymouth plant for the last five years, has been loaned to the National Defense Commission. Mr. Chapman will devote his efforts to assisting the Commission in organizing

V-P Hardinge Inc.

RAY H. MORRIS

Heads Canada's G-M

W. S. ROBERTS

President, Board Chairman, Norton Co.

GEORGE N. JEPPSON

ALDUS H. HIGGINS

and directing the vast industrial machinery of the country.

Harold S. Falk has been appointed general superintendent, The Falk Corp., Milwaukee.

E. N. Horr has been elected vice-president and general manager, Cowles Detergent Co., Cleveland. C. C. Bassett, and C. C. Barrett have been elected vice-president, and secretary-treasurer respectively.

George N. Jeppson has been elected president, Norton Co., Worcester, Mass. He succeeds Aldus C. Higgins, who resigned to become chairman of the board, a position vacant since the death last year of Charles A. Allen. Mr. Jeppson has been vice-president and treasurer of the company. He became associated with the company 49 years ago, while Mr. Higgins became a member of the organization 40 years ago.

Thomas B. McCabe has been elected a director of Air Reduction Co., New York, N. Y.

Addison McGarrett has joined the sales department of Reed-Prentice Corp., Worcester, Mass. He was formerly connected with the Pratt & Whitney Co., Hartford, Conn. F. W. McIntyre, vice-president and general manager, Reed-Prentice Corp., has been appointed to the machine tool co-ordinating committee, National Defense Advisory Commission.

P. A. McTerney has been appointed manager of sales, motor and generator division, General Electric Co., Schenectady, N. Y. G. E. Cassidy has been named engineer, general applications section, and J. S. Overstreet has been placed in charge of wire and cable sales, G-E Wire and Cable Div.

Ray H. Morris, has been elected vice-president, Hardinge Bros. Inc., Elmira, N. Y. Mr. Morris, who will be in charge of their branch plant at West Hartford, Conn., has been associated with the company since 1932.

L. A. Mullen has been appointed manager of sales, tubular products, Pittsburgh Steel Co., Pittsburgh, Pa.

L. E. Osborne, manager of manufacturing and engineering, Westinghouse Merchandising Div., Westinghouse Electric & Mfg. Co., has been named to the staff of the National Defense Advisory Commission.

Lynn Reynolds, formerly metallurgical engineer for Worthington Pump & Machinery Corporation, has been appointed chief engineer for Adel Precision Products Corporation, Los Angeles.

W. S. Roberts, formerly general manager, Linden Div., General Motors Corp., has been appointed vice-president and general manager, General Motors of Canada. Mr. Roberts succeeds Harry J. Carmichael who has resigned to direct Canadian Government defense production activities.

M. P. Robinson, proprietor, Robinson Filter Co., has joined the Worthington Pump & Machinery Corp., Harrison, N. J., to take charge of the corporation's newly organized water purification equipment division.

Fred Rockelman has been appointed liaison officer between Douglas Aircraft Co., Santa Monica, Calif., and its automotive sub-contractors in Detroit.

M. W. Rogers, formerly general factory manager in charge of production, Caterpillar Tractor Co., has been named president, Potts Machine Co., Jackson, Mich.

A. R. Rutter has been appointed assistant manager of the engineering department, Westinghouse Meter Div., Newark, N. J., and Charles Cook has been named manager, Steam Service, South Philadelphia Works of the Westinghouse Electric & Mfg. Co. Edward D. Gangwere has been appointed director of equipment, and Homer B. West has been appointed manager of manufacturing in the transformer division, Sharon, Pa.

D. A. Samson formerly operating manager, Dodge Factory, Chrysler Corp., has been appointed operating manager of the corporation's Warren Ave. plant which will be used for the manufacture of airplane parts.

J. H. Schermerhorn and E. M. Cabaniss have been elected president and vice-president in charge of manufacture, respectively, Joseph Dixon Crucible Co., Jersey City, N. J.

A. W. Secord has been named director of manufacturing, International Harvester Co., while M. J. LaCroix, formerly works manager in charge of the automotive group, is now manager of manufacturing. K. O. Schreiber has been appointed works manager of the tractor group, and M. J. Graham, works manager of the truck group.

Charles A. Simmons, Sr. president, Simmons Machine Tool Corporation, Albany, N. Y., has been appointed to the National Defense Advisory Commission. Because of his 30 years of leadership in used and rebuilt machinery he will be attached to the machine tools and heavy ordnance section of the defense commission.

F. L. Toy has been named assistant manager, technical development, Carnegie-Illinois Steel Corp.

James M. White, formerly assistant to manager, Allis-Chalmers Mfg. Co.'s LaPorte, Ind. Works, has been named assistant to the vice-president in charge of manufacturing.

PLANT EXPANSION

Capewell Mfg. Co., Hartford, Conn., is increasing its manufacturing capacity for hacksaw blades over 50 per cent.

Clark Equipment Co., Buchanan, Mich., will expand its present facilities at a cost of $2,500,000 for the manufacture of truck housings and transmissions.

Cleveland Pneumatic Tool Co. will expand its plant at a cost of $5,000,000. The government is financing the expansion.

Curtis Lighting, Inc., Chicago, has begun construction of a one-story factory building which will add 100,000 sq.ft. of floor space.

The Federal Shipbuilding and Dry Dock Co., Kearny, N. J., subsidiary of U. S. Steel Corp., is proceeding with arrangements to acquire 15¼ acres of land at Kearny for expansion operations to consist of additional ship ways, an outfitting station, and miscellaneous crane equipment and service buildings.

Hammond Machinery Builders, Inc., Kalamazoo, Mich., manufacturers of grinding and polishing machinery, have expanded their manufacturing facilities with a new plant addition which provides for double the former manufacturing space.

Liberty Aircraft Products Corp., Farmingdale, L. I., is constructing a new plant addition at a cost of $1,088,000, equipment and machinery included. The new building, financed by the RFC, will be used for the manufacture of airplane parts.

Manning, Maxwell & Moore, Inc., Bridgeport, Conn., have expanded their plant more than 50,000 sq.ft. of floor space.

Reed-Prentice, Worcester, Mass., has contracted for plant expansion of building and machinery at a cost of $400,000, in order to double the capacity of their production of engine and toolroom lathes.

Rheem Mfg. Co., Chicago, manufacturer of metal products, has purchased 40 acres of land as a site for a second plant where $4,000,000 of bomb fins and practice bombs will be manufactured. The new plant will be erected and equipped at a cost of about $500,000.

Sterling Engine Co., Buffalo, N. Y., will begin construction of additional assembly facilities at an approximate cost of $500,000.

Thompson Products Co., Cleveland, will build an $11,000,000 plant at Euclid, Ohio, to manufacture aircraft parts. The factory will comprise 575,000 sq.ft. of floor space and have the capacity to manufacture a product valued at $22,000,000 annually.

Warner & Swasey Co., Cleveland, has rented the former Mid-town Motors building for the assembly of turret lathes for the British Government.

The Wesson Co., Detroit, manufacturers of cemented carbide and high-speed steel cutting tools, has begun construction of a new plant. The expansion will more than double the capacity of the company's present facilities.

BUSINESS ITEMS

Aircraft Precision Products, Inc., Los Angeles, has been incorporated with 100 shares of no par value stock.

Cosa Oversea Trading Corp., New York, N. Y., has been appointed exclusive agent for the distribution of Maag Gear Cutting and Gear Grinding machines, manufactured by the Maag Gear-Wheel Co., Ltd., Zurich, Switzerland.

Grede Foundries, Inc., Milwaukee, has been formed with a capitalization of $1,000,000.

Grenby Mfg. Co., Inc., Plainville, Conn., has purchased the Bergram Mechinical Engineering Co., New Britain.

R. S. Stokvis & Sons, Inc., formerly of Rotterdam, has moved to Willemstad, Curacao, Dutch West Indies.

OBITUARIES

Col. F. B. Richards, 78, for many years prominent in the metal industries in Cleveland, Pittsburgh, and other centers, died recently. He had retired ten years ago. In 1933 he joined the M. A. Hanna & Co., Cleveland, and remained associated as a director of this company until his retirement.

Richard J. Arnold, General Motors manager in Mexico City, died recently of pneumonia while on a visit to the U.S.

Frank E. Bardrof, 51, former associate editor of AMERICAN MACHINIST, died recently after a year of poor health. Mr. Bardrof also served as sales manager, Cleveland Worm & Gear Co., and as associate editor, *The Glass Industry*, a position which he held at the time of his death.

Alfred C. Getz, 72, vice-president and founder of the Sidney Machine Tool Co., Sidney, Ohio, died recently. Mr.

Dies at 72

ALFRED C. GETZ

Getz founded the Sidney Machine Tool Co., in 1904, and acted in the capacity of secretary and general manager until 1937 when he retired from active service.

Henry C. Grover, 57, superintendent of Plant No. 1 of the Aluminum Goods Manufacturing Co., Two Rivers, Wis., died recently.

Stanley Barbour Hildreth, 95, manufacturer and inventor of the cyclometer, forerunner of the modern speedometer, died recently at his home in Cambridge, Mass.

Frank Ellsworth Randall, 80, pioneer in the manufacture of dial gages and precision instruments, died recently at Waltham, Mass., following an operation.

Winfield H. Smith, 79, president, Winfield H. Smith Co., Inc., Springville, N. Y., gear manufacturer, died in Buffalo, N. Y., January 14.

Elmer E. Woodward, 78, president, Woodward Governor Co., Rockford, Ill., died recently. Mr. Woodward was a national authority on speed control and an inventor.

MEETINGS

American Society of Mechanical Engineers. Spring meeting. Atlanta, Ga., April 1-3.

American Society of Tool Engineers. Annual meeting. Detroit, Mich., March 24-29.

Machine and Tool Progress Exhibition. Sponsored by the American Society of Tool Engineers. Convention Hall, Detroit, Mich., March 25-29.

Society of Automotive Engineers. National Aeronautic Meeting. Washington Hotel, Washington, D. C. March 12-14.

SHOP EQUIPMENT NEWS

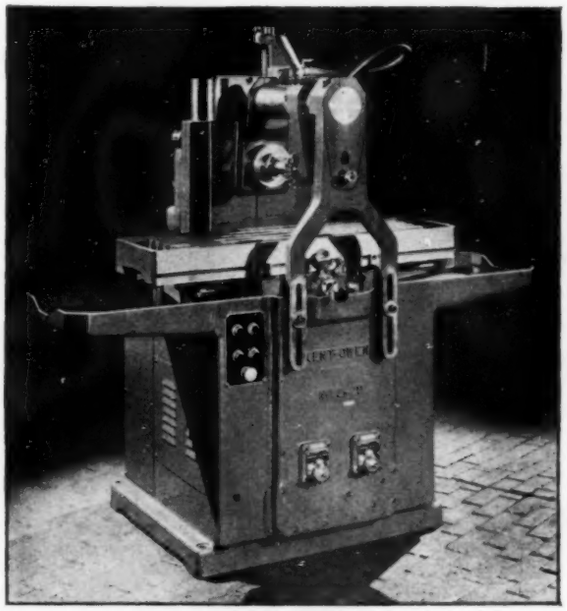
Independent Feed Adjustment Features Kent-Owens Automatic Milling Machine

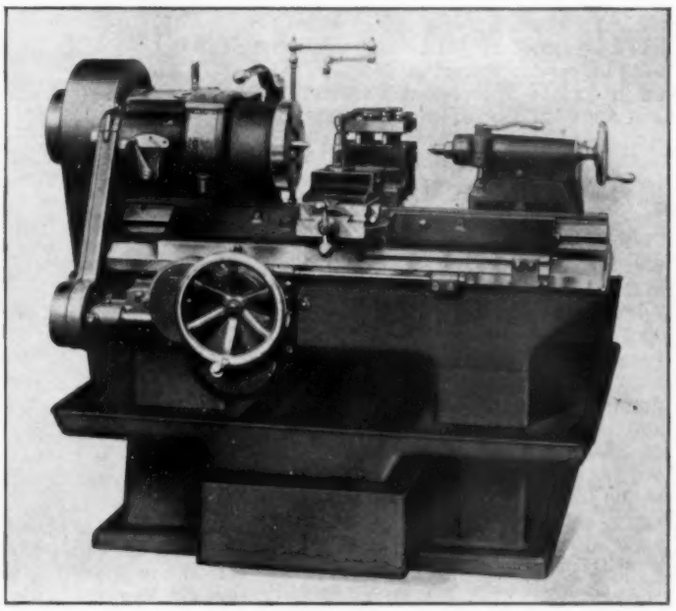
Independent rate of feed adjustment is an outstanding feature of the No. 2-20 automatic milling machine developed by Kent-Owens Machine Co., 958 Wall St., Toledo, Ohio. Control is such that the table can be fed or rapid traversed in either direction, automatically shifted from rapid traverse to feed in either direction, and automatically reversed at both ends of the stroke. It also may be automatically stopped at any desired point in its travel.

Still another feature permits independent adjustment of feed rate for opposite directions of table travel. This makes possible doing one operation at one end of the table and an entirely different operation at the other end. Each direction of table travel has a separate feed rate control dial which is adjusted independently of the other. Any of three spindle speed ranges can be furnished. A medium range of 64 to 860 r.p.m. is standard equipment, while a low range of 32 to 428 or a high range of 96 to 1284 r.p.m. can be provided. Wide face, quiet running pick-off gears are spline mounted and are easily removed for making spindle speed changes. All gears run in oil.

Head is mounted on two cylindrical ground steel posts with the spindle midway between them. This gives a balanced design and is claimed to eliminate any possibility of overhang or cocking action. Spindle is driven by a motor at the rear of the machine, and the hydraulic pump by a separate motor in the base. Both motors are standard foot mounted ball bearing types and are readily accessible. There are only two gear contacts in the spindle drive from the motor to the cutter.

Specifications: table size, 42 x 12 in.; table travel, 20 in.; table surface to spindle center, 13 in. maximum, 4 in. minimum; spindle speed range, 13.35:1; table feed range, ¾ to 38 in. per min.





LeBlond "Multi-Cut" Automatic Lathes Designed for Ease of Tooling Changes

R. K. LeBlond Machine Tool Co., Cincinnnati, Ohio, has designed the 6-in. and the 9-in. "Multi-Cut" lathes especially for easy set-up of separate tools for turning, facing, necking, and grooving. In these automatic lathes all tools go through their cycles and finish at the same time. Operation is completely automatic from the time the work is put into the lathe until the cycle is complete. At the end of the cycle of cuts a handwheel returns the tools ready for the next part to be machined.

Feed variations for the turning and facing sides are obtained by change gears applied to the feed bracket and the worm box. Feeds are graduated in thousandths per revolution of the spindle. A direct-reading work diagram shows various change gear combinations and each of their resulting feeds.

Relationship between slides is quickly adjusted by setting a movable profile swivel plate. As facing or forming tools approach the end of cut the feed is retarded and stops as the roller rides on the land of the profile guide plate.

Hunter Hobbing Machine Finishes Die Cast Gears

A special hobbing machine designed by Hunter Engineering Co., Blaine & Pachappa Sts., Riverside, Cal., finishes worm gears from plain die cast zinc alloy blanks at a rate of 960 pieces per hour. A turret with six work holding spindles, each with an overarm which automatically swings over and drops to clamp the blank throughout the cut, contributes to this high production rate.

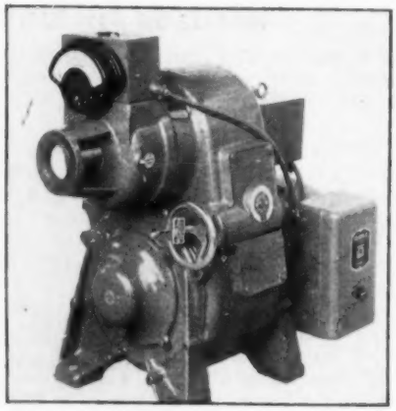
Overarms are operated by cams which lift and swing the arms to leave open one spindle for ejection and two for reloading at all times. Another cam ejects the blanks automatically, so that

the operator's work is limited to loading the blanks on the spindles. A chute collects finished gears.

Rapid traverse between cuts is provided. Blank is synchonized with the hob by a worm gear train. Gears are hobbed without coolant. Finished gear has 18 teeth of 24 pitch and measures 0.833 in. outside diameter. Hob is 0.617 in. in outside diameter, of 0.1309 pitch and 0.2618 in. lead, with four gashes.

"Speed-Trol" Test Stand Accomodates Many Devices

Sterling Electric Motors, Inc., Telegraph Rd. & Atlantic Blvd., Los Angeles, Calif., has designed the "Speed-Trol" multi-purpose variable speed stand especially for routine testing of such equipment as generators, alternators, and small vacuum, hydraulic and fuel pumps. Standard units are designed for continuous operation and are furnished with 5-hp. motors providing infinite speeds from 1000 to 5000 r.p.m., obtained by a simple handwheel adjustment. No gears are used in the mechanism, which is totally enclosed. It is claimed that speed is constant at any setting regardless of load imposed by device being tested.

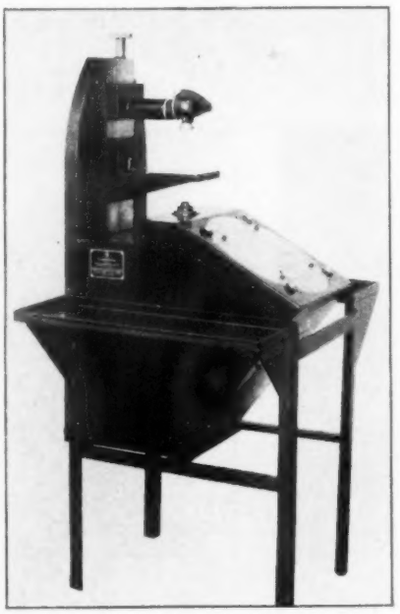


J. & L. Optical Comparator Checks Small, Flat Objects

Jones & Lamson Machine Co., Springfield, Vt., has designed a vertical optical comparator especially for checking small flat objects which can be placed directly on a glass stage. With this device a greatly enlarged shadow of the contour is projected onto a screen, where its outline can be compared with that on the screen itself.

Of rugged construction for shop use, this all-metal machine will project a maximum diameter of 1.5 in. with a 6X magnification, and a 0.140 in. diameter with 100X magnification. A rugged 8-in. diameter ground and lapped mirror, coated with aluminum oxide, is used to reflect the image on a 14-in. diameter screen in a position convenient for the operator.

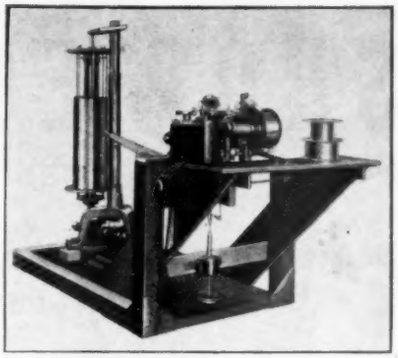
Available with the machine is a table for making coordinate measurements.



Slides are of hardened steel, and 5/16-in. diameter balls which support and guide the slides operate in accurately ground V-ways. This table will measure up to 2 in. sideways and 1 in. backward or forward. It can be equipped with micrometers graduated to read to 0.0005 in.

Fine Wire Handled Easily By Automatic Spool Winder

Finest gages of either bare or cotton covered wire are claimed to be handled successfully with the automatic spool winder developed by General Engineering & Mfg. Corp., 35 Verona Ave., Newark, N. J. This machine may be arranged to maintain constant wire speed with consequent variation in spool spindle speed, or for constant spool spindle speed with the necessary varying wire speed.

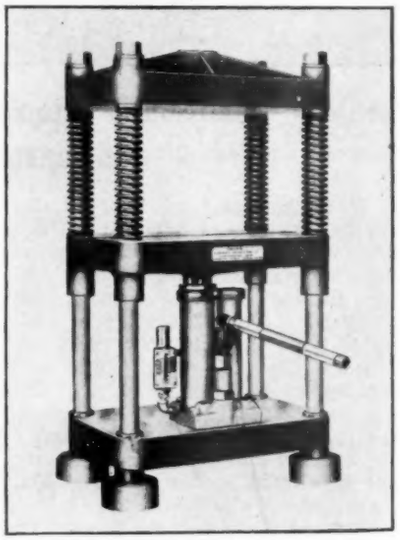


It is claimed that the machine can be started and stopped repeatedly while spooling without damaging even the finest wire. Extremely close control of spindle speeds is exerted throughout all ranges, this control being entirely automatic. When the spool is filled to the desired point, machine automatically stops. Machine can also be set to stop when a given wire footage has been wound. Unit maly be installed on existing tables or benches, or is available on a light portable welded steel frame. Entire arrangement weighs about 500 lb.

Pacific Hydraulic Press Shears in Punches and Dies

A hand hydraulic press built by Pacific Hydraulic Press & Tool Co., P. O. Box 87, Huntington Park Sta., Los Angeles, Calif., has been especially devised for shearing in punches and dies. Also adaptable for experimental work on molds, this device is a leakproof hydraulic unit and automatically cuts out to prevent overloading.

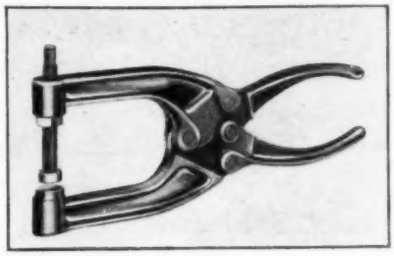
Two sizes of machine are available—the 15-ton model having 12x18-in. platens, and the 20-ton model having 18x24-in. platens. On both models stroke can be controlled by stop collars which give an instrument range from zero to maximum.



Knu-Vise Toggle Pliers Feature Large Depth of Throat

A throat capacity of 1½ x 3 in. is provided in the Model No. 450 rapid action toggle pliers introduced by Knu-Vise, Inc., 16841 Hamilton Ave., Detroit, Mich. This throat depth permits the work to be held several inches from the edge of the sheet or board.

Forged from SAE 1020 steel; the pliers are hardened and tempered and

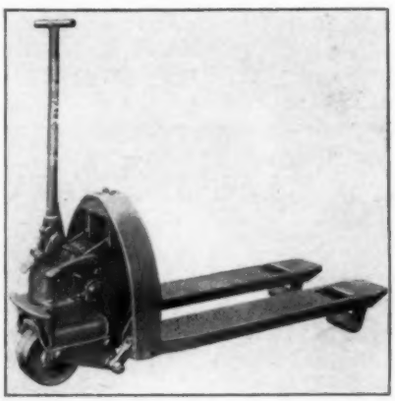


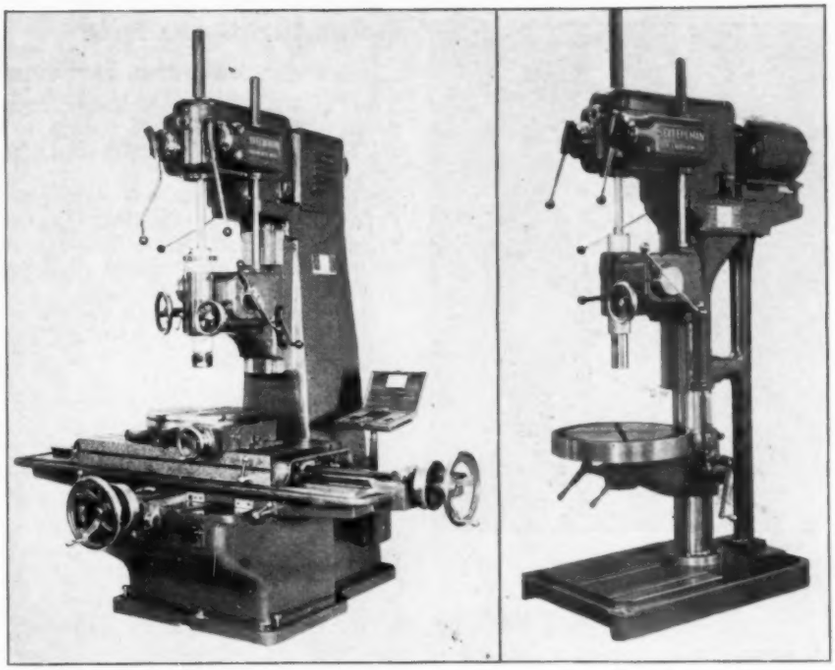
provide a pressure ratio of 93:1. They are manually applied simply by squeezing the handles, automatically locking in position and holding positively until released. They are quickly adjustable to accommodate different thicknesses by means of small screws in the upper jaw.

Hand-Operated Pallet Truck Offered by Yale & Towne

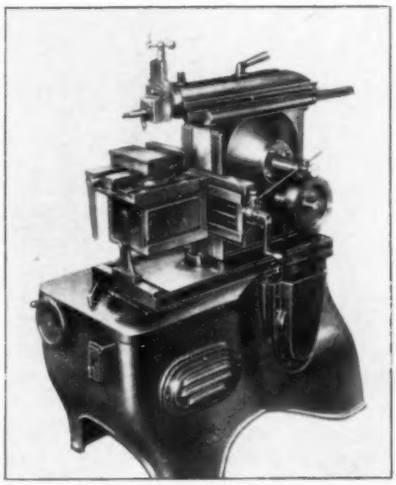
Yale & Towne Mfg. Co., Philadelphia Div., Philadelphia, Pa., has developed the Type Y4RP-9 pallet truck to bring the economies of pallet-load handling of materials within the scope of hand truck operations. This device is said to be a valuable supplement to electric truck handling, as it is particularly useful for short hauls and for operation in close quarters.

Multiple stroke lifting mechanism is said to provide virtually effortless lift. All wheels are ball bearing equipped for smooth operation. Safety is assured through a positive lock. Hydraulic release check cushions descending loads. The truck is made in frame widths of 25, 27 and 30 in., and in lengths of 36, 42, 48, 54 and 60 in. Capacities range up to 4,000 lb.





Improved Jig Borer and Drilling Machine Provide Increased Speed and Accuracy



Recent improvements incorporated in Cleereman jig borers and drilling machines, available from Bryant Machinery & Engineering Co., Sales Div. of Cleereman Machine Tool Co., 400 W. Madison St., Chicago, Ill., include various refinements to provide increased speed, accuracy and ease of operation.

The jig borer features a sliding head which is better ribbed for greater rigidity. Faster operation is promoted by addition of power rapid traverse to the table. A new spindle control switch on the base is located in front of the operator. With it one lever provides forward, reverse and stop with brake on and brake release. Absence of interlocks prevents mistakes. New type binders for saddle, table and spindle head are easily adjusted for position and are claimed to be absolutely non-influencing. A new feed reverse is included. This machine is available in three table sizes: 16 x 30, 16 x 36 and 22 x 44 in. Rotary tables are made in 16 and 20 in. diameters.

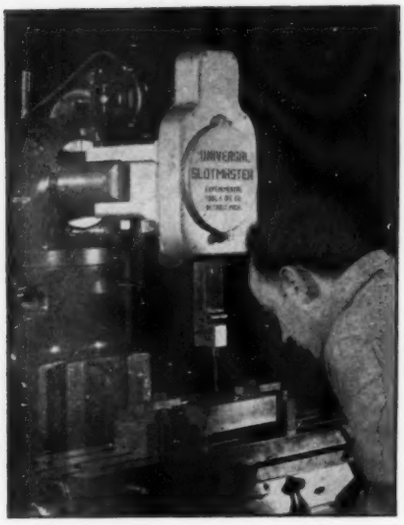
An outstanding improvement on the high-speed drilling, boring and tapping machine is a feed clutch which is said to be exceptionally powerful yet easy to operate. Ground feed worms reduce friction, prolong life and help provide increased capacity. New feed trip dial is mounted on anti-friction bearings. Larger trip dogs provide greater rigidity, better accuracy and longer life. Base for the 30-in. size provides greater rigidity, more toe room and greater coolant capacity. A safety joint in the feed shaft is included to prevent damage in case of accidental jamming of spindle. These machines are made in 21, 25 and 30 in. sizes.

Machinery Manufacturing Shaper Has Infinite Number of Speeds

An infinite number of speeds, available by turning a handwheel on the machine base, is provided by the precision shaper built by Machinery Manufacturing Co., 1915 51st St., Vernon, Los Angeles, Cal.

The base of this machine is designed to give foot room for the operator on both sides and at the front. Rugged construction reduces noise and damps vibration. Motor and hanging base mountings are cast integrally with pedestal to assure accurate alignment.

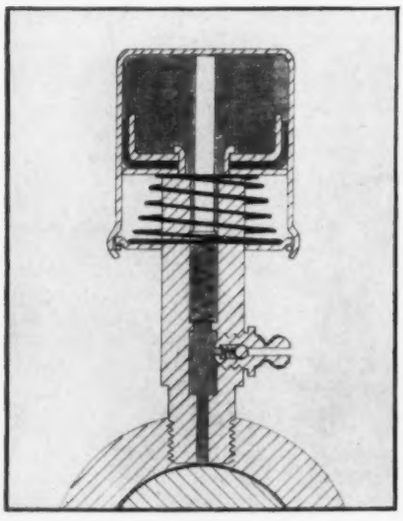
The shaper has a maximum stroke of 11¼ in. Ram length is 21 in. 50 to 150 strokes per min. are provided. Floor space required is 24x36 in.



Universal Slotting Head Fits All Milling Machines

A universal slotting head which can be used on all types of milling machines has been developed by Special Machine Div., Experimental Tool & Die Co., 12605 Greiner Ave., Detroit, Mich. This machine can be used for cutting keyways, templets, splines, internal gears and for slotting out precision blanking dies or wherever sharp corners and special shapes must be machined.

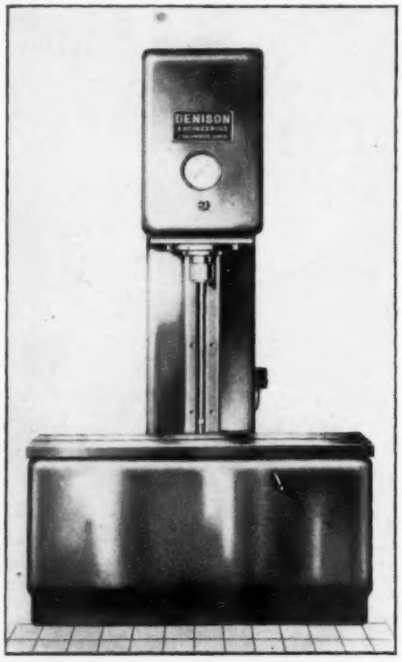
Ram stroke is adjustable from 0 to 4 in., with adjustment quickly and accurately accomplished. The head is equipped with a ¼-hp. motor with four speed changes, the speeds ranging from 50 to 250 or from 100 to 580 strokes per min. Clapper-box type toolholder can be turned in any position. Housing is of cast aluminum with all working parts made of graphitic steel, heat-treated and ground. Preloaded Timken bearings are used throughout. Gears are hardened and ground. Over-all length is 18 in.; width 8 in. and depth 12 in. Machine comes with a mounting adaptor for any milling machine.



Denison Straightening Press Manufactured in Two Sizes

Type DLSC2 hydraulic straightening press built by Denison Engineering Co., 236 N. Water St., Columbus, Ohio, is available in capacities of 25 or 50 tons. Adapted to a wide range of production straightening, this press will handle round bars, flats, tubes, structural shapes, castings and finished parts on a production or small-lot basis.

Ram and cylinder assembly is located in the upper part of the C-frame, the directional control valve and its operating mechanism are located in the upper part of the vertical column of the frame, and the motor, pumps and tonnage control are in the center. Oil reservoir is located in the lower section. The press can be furnished with

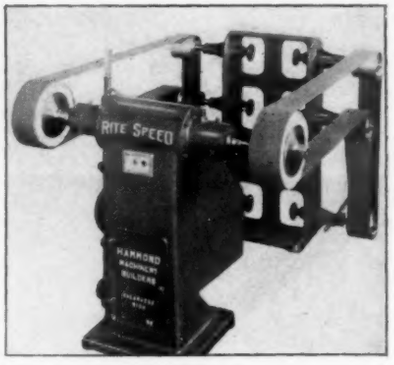


control by hand lever in either one of two locations or by foot pedal. Pressure is controlled by motion of the single operating lever. A constant-volume vane type pump, driven by 5- or 7½-hp. motor, is used.

"Ace" Automatic Lubricator Shows When Cup Is Empty

The "Ace" automatic lubricator offered by Ace Lubricating Equipment Co., 2345 W. Grand Blvd., Detroit, Mich., shows at a glance when refilling is necessary. This lubricator is filled with a gun, eliminating waste and lost time. It can readily be taken apart and cleaned, and can be adjusted to suit bearing fits and lubrication requirements.

Design of the device is such that it maintains constant pressure on the lubricant, thus excluding dirt, dust and water. It is equipped with a safety valve to prevent damage when a high-pressure gun is used.

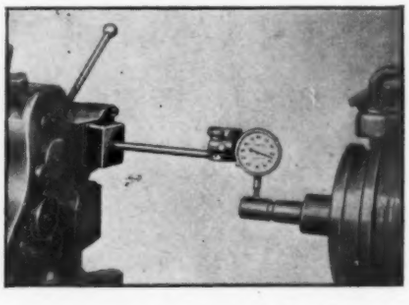


Abrasive Belt Polisher Improves Lathe Operation

Hammond Machinery Builders, 1618 Douglas Ave., Kalamazoo, Mich., has developed an abrasive belt stand for use in conjunction with polishing and buffing lathes. Shown with a Model No. 7-CH "Rite-Speed" polishing lathe, this stand is equipped with a 5-in. belt, although wider or narrower belts can be furnished to suit particular applications. Proper tension of belts is maintained by an adjustable pulley. Belts can be quickly removed and replaced.

Magnetic Indicator Base Simplifies Dial Gage Mounting

A convenient stand for use with any type of dial gage indicator, which utilizes a powerful "Alnico" magnet base to hold it to any iron or steel surface, has been developed by Mellaphone Corp., Rochester, N. Y. Equipped with a ⅜-in. diameter non-magnetic post, the magnetic base is said to be sufficiently powerful to support the indicator at the extreme end of the post even when the base is in contact with an unmachined surface. Thus it may be used in any position without danger of slipping or falling off. It eliminates the necessity for special holders, clamps and other dial gage fixtures. It is claimed that the magnetism will last for years without weakening and that it is unaffected by rough usage.



"Hot Blade" Wire Stripper Handles All Insulations

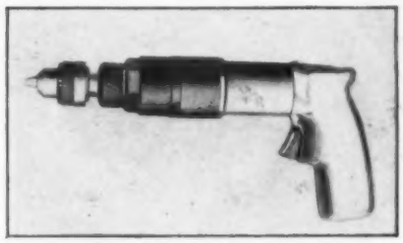
All types of insulations on either stranded or solid wire can be stripped quickly and easily with the "Hot Blade" wire stripper developed by Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill. With this device it is claimed that up to 12,000 wire strippings per day are easily possible. It is said that there is no possibility of cutting the strands, nicking, scraping or otherwise injuring the wire in any way, as the blunt blade cannot harm the finest wire.

Operation is simple. Wires are merely inserted between the electrically heated blades in the stripper head. Pressing the foot pedal brings the blades against the insulation and two parallel grooves are burned down to the conductor. These grooves are completed with a slight twist, and a pull removes the insulation. Strippings fall into a water drawer where any burning particles are quickly extinguished.

Each blade has an individual heat control and transformer so that burning temperatures can be separately raised or lowered. Distance between blades and length of stripping are adjustable. Standard parts include head, control box with transformer, water drawer, pedal and connecting rod.

"Multi-Vane" Air Drills Feature Extreme Light Weight

Ingersoll-Rand Co., Phillipsburg, N. J., has designed Sizes 00 and 0 "Multi-Vane" drills to incorporate extreme light weight—the weight ranging from 1½ to 2⅞ lb. Attachments adapt these tools for light screw driving, nut running, close-quarter drilling, wire brushing and sanding. Straight, lever throttle and pistol grip handles are available.



Long Horn Seam Welder Offered by Thomson-Gibb

Containers requiring longitudinal seams as long as 54 in. and circular seams as small as 10 in. in diameter can be fabricated on the long-horn seam welder designed by Thomson-Gibb Electric Welding Co., 164 Pleasant St., Lynn, Mass. Change-over from circular to longitudinal welding is readily accomplished by substituting a different welding head at the end of the lower arm and by swiveling the upper head through a 90-deg. arc.

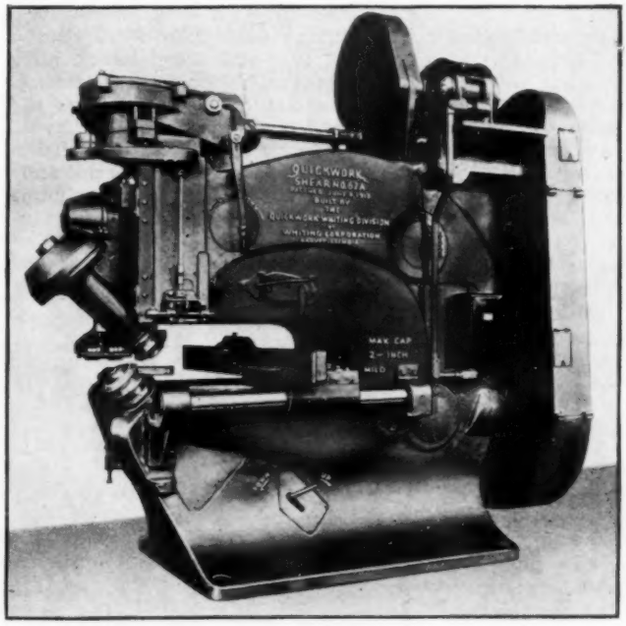
Welding speed is variable from 2 to 12 ft. per min., which is accomplished by combining a two-speed motor with a variable-speed drive. A 16-point regulator and separate electron control apparatus permit a wide range of pressures as high as 2,000 lb. Transformer capacity is 300 kva.

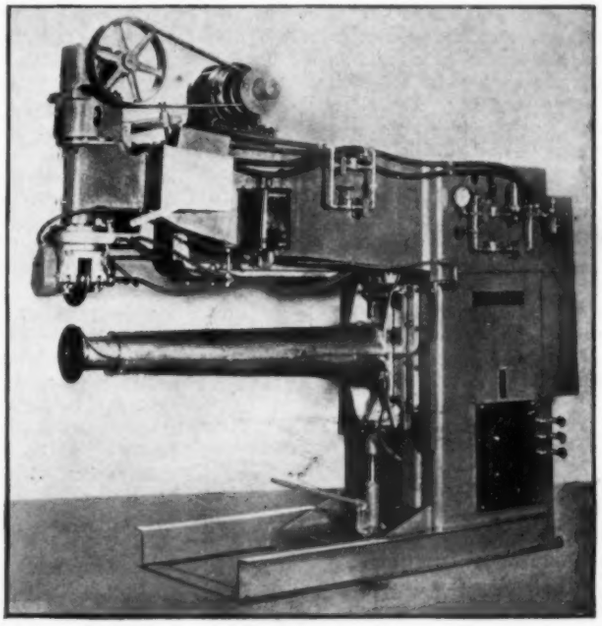
Upper welding shaft, head and head bracket and lower welding arm are all water cooled. Separate water circuits are used to insure ample flow of cold water. Transformer is water-cooled, while both upper and lower wheels are flood cooled. A hydraulic jack provides an 8-in. adjustment of the vertical arm bracket.

"Quickwork" Rotary Shear Cuts Through Mild Steel Plates of 2-in. Thickness

Mild steel plates up to 2-in. thick can be cut with the Model No 62-A "Quickwork" rotary shear built by Quickwork-Whiting Div., Whiting Corp., Harvey, Ill. In addition to increased capacity, this shear operates at higher speeds than previous models.

For straight cutting of 2-in. plates having a tensile strength of 65,000 lb. per sq. in., it can shear at speeds up to 50 ft. per min. It will also shear 1-in. plates with a tensile strength of 130,000 lb. per sq. in. at the same rate. Attachments permit the machine to cut circles and irregular shapes at comparable speeds. It is also possible to perform beveling and joggling on the same machine.





G. E. Incandescent Searchlight Helps Prevent Night Sabotage

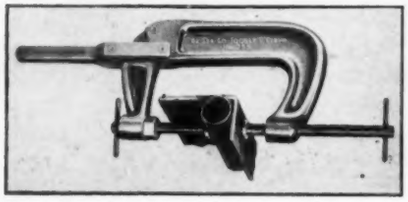
General Electric Co., Schenectady, N. Y. has developed a low cost 18-in. 1,000–1,500 watt incandescent searchlight especially for use in protective lighting systems to prevent sabotage. This searchlight, equipped with high or low pedestal, can be furnished with either pilot-house or hand control at the factory.

A silvered glass parabolic reflector provides accurate control of the light. A spherical auxiliary reflector from the lamp eliminates stray light and helps build up beam intensity. Sheet aluminum casing and clamped on door glass make the searchlight completely weatherproof.

Quick-Acting Toggle Clamp Swings Clear of Work

Detroit Stamping Co., 343 Midland Ave., Detroit, Mich., has devised a toggle clamp having the lower half swinging clear of the work, enabling the operator to get around obstructions in fixtures and to clamp firmly such pieces as angle or T-shaped iron. Two-rod adjustment permits holding the work accurately. Once it is set, this adjustment need not be varied until a particular job is finisned.

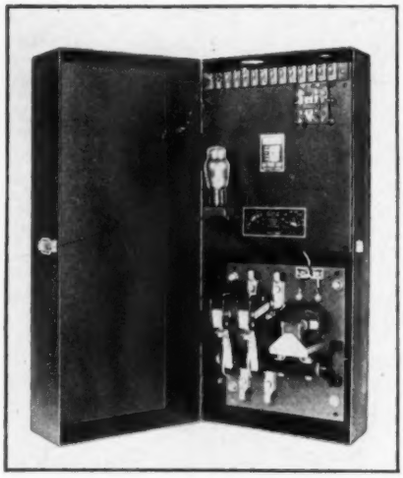
Two models of this clamp are available. One has two threaded rods which permit quick adjustment. The other has two smooth rods which are held in place by setscrews. This clamp is said to be especially suited to arc welding work, as it has no threads to become clogged with spatter. Both clamps are fabricated of malleable iron with steel rods. Toggle handles are of case-hardened steel. They are designed to exert pressures in the neighborhood of 1,000 lb.



Weltronic Timer-Contractor Controls Welding Machine

To reduce the skill required in timing welds and assure uniformity, a timer-contactor to be used with any 15- to 35-kva. manually or mechanically timed spot welder has been developed by Weltronic Corp., 3051 E. Outer Drive, Detroit, Mich. Available for 220, 440, or 550 volts and for 25, 40, 50 or 60 cycles, this Model 108–53 unit is adjustable over a timing range of 2 to 30 cycles. Two control knobs provide close adjustment.

Long life and low maintenance costs are claimed for this controller. A specially-designed high-speed heavy-duty contactor is employed. Contacts of



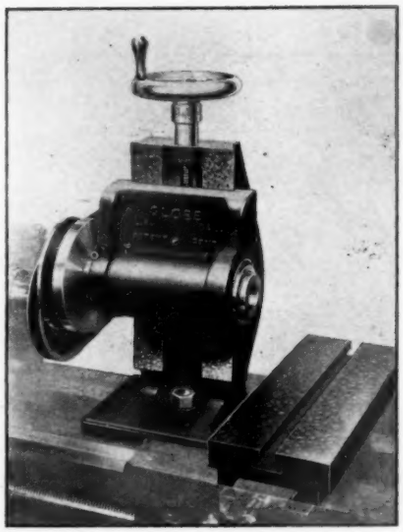
both contactor and relay are quickly removable for replacement, and the entire unit can be serviced without skilled help. It consists of an electronic tube, relay and magnetic contactor inclosed in an 11 x 13 x 30-in. case.

Utility Transfer Truck Handles Batteries and Dies

Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass., has designed the No. 1917 heavy utility transfer truck especially for carrying heavy storage batteries for electric trucks to the charging board and return, thus permitting charging of batteries anywhere in the plant. The device is also suitable for the transfer of dies and similar parts.

The unit consists of a heavy arc welded steel frame, roller top, and a winch operated by a two-speed crank mounted on a running gear consisting of 8 in. semi-steel wheels and plate-type ball-bearing swivel casters, all mounted on roller bearings, pressure lubricated and equipped with rubber tires.

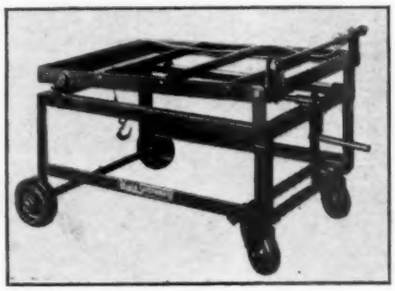
Capacity of the truck is 2500 lb. Deck measures 44 x 30 in. Height of forward end of deck is adjustable from 26 to 27 in. Rear end of deck is 28 in. high. An extra heavy-duty type with hydraulic lift is also available for special applications.



Globe Milling Attachment Suitable for Many Lathes

Globe Products Mfg. Co., 3380 Robertson Blvd., Los Angeles, Calif., has developed a lathe milling attachment which employs the lathe spindle for drive and makes use of the carriage movements to operate its table. Spindle is carried on a vertical slide so it can be easily moved up and down. Ball bearing arbor support attaches to the lathe tailstock spindle so that a cutter arbor can be applied in a manner similar to that of a standard plain milling machine with an overarm. It also is possible to mount a chuck on the end of the arbor at the milling head in raised position and set a standard lathe tool on a block on the carriage to swing larger work in a turning operation than the lathe will take on its own headstock.

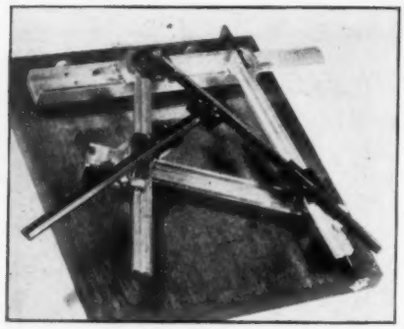
Ball bearing spindle is driven by V-belts to permit vertical positioning through 6 in. Over-all dimensions of the table are 4½x12 in. The attachment is available for Atlas and Craftsman lathes (other than 6 in. sizes), 9 and 11 in. South Bend lathes, and 10 and 11 in. Sheldon lathes. It may also be attached to other makes of lathes, and larger sizes of lathes, by a special adapter base plate. A slight change in the cross-feed screw nut and machining of the base of the column and the table are necessary in order to adapt the device to lathes other than those for which it is specifically intended.



The mounting of the spindle block — straddled by two uprights and clamped solidly together — provides a wide support base and an unusually rigid spindle structure.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.

MILWAUKEE MILLING MACHINES



"Cal-Ku-Scope" Calculator Simplifies Drafting Problems

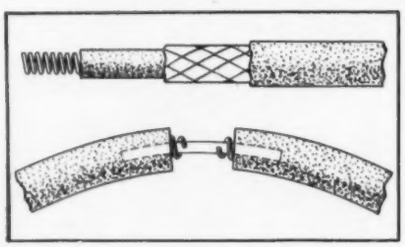
Many types of drafting problems involving the solution of sides and angles of triangular and quadrilateral figures are easily solved by the aid of the "Cal-Ku-Scope" triangulation calculator developed by Cal-Ku-Scope, Inc., 233 Broadway, New York, N. Y. With this device any triangulation problem which can be worked on paper is said to be solved in considerably less time with somewhat better accuracy.

In effect, the device reproduces in miniature the particular geometric figure whose unknowns it is desired to solve. Verniers on the sliding element permit setting the machine and reading it to within 0.001 in., while verniers on the protractor-equipped pivots permit setting and reading to within 5 min. Thus, once any geometrical figure is set up on the machine, all dimensions and angles are read instantly. Additional elements permit reading of either diagonal and length of any perpendicular from a corner to either diagonal.

No Fasteners Are Required With "Round-Tex" Belting

Because of a built-in spiral spring core construction, no fasteners are required to join the ends of "Round-Tex" belting developed by Sudbury Laboratory, Box 979, South Sudbury, Mass. Ends of the belts are joined simply by screwing the spiral spring cores at each end into one another.

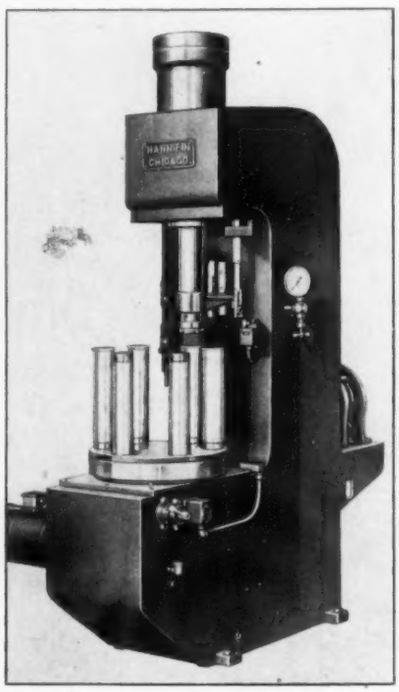
Construction of the belting consists of rubber tire tread stock molded onto the core. This stock is covered by a layer of braid which in turn is covered with tire-tread rubber. This construction is claimed to provide extremely long life, accurate belt section and high co-efficient of friction, all of which contribute to better service.



Shell Case Marking Press Features Automatic Operation

Hannifin Mfg. Co., 621–631 S. Kolmar Ave., Chicago, Ill., has developed a hydraulic press for marking 75-mm. shell cases which operates with a rapid, automatic cycle of approximately 4 sec. Capacity of the press illustrated is 20 tons. A 10-ton model is also available.

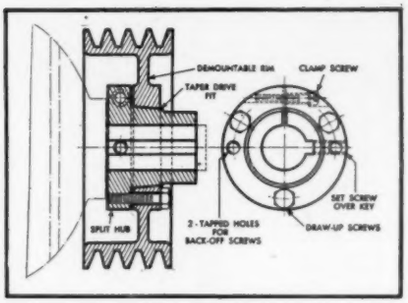
Ram is fitted with a marking die, and when once started operates continuously, with automatic reversal at top of the stroke and automatic reversal governed by maximum pressure at bottom of the stroke. Pressure-governed reversal at the end of the working stroke is said to insure uniform maximum pressure on the die. Both maximum pressure and stroke of ram are adjustable. Adjustment of length of stroke avoids unnecessary up-travel of ram and allows varying the cycle of operation.



An electrical control actuated by the ram on the return stroke operates the indexing table. The circular table is equipped with six mandrels. The table indexing mechanism runs in oil, and is driven by a ¾-hp. motor with electric brake, automatically controlled to advance the table on position with each return stroke of the ram. The operator has only to start the press, and load and unload the fixture as the table advances.

A motor-driven hydraulic power unit is built into the rear of the press, making it a self-contained unit requiring only electrical connections to complete the installation. Press frame, table support, and power unit mounting are of welded steel construction.

Press is also suitable for many other types of pressing operations.



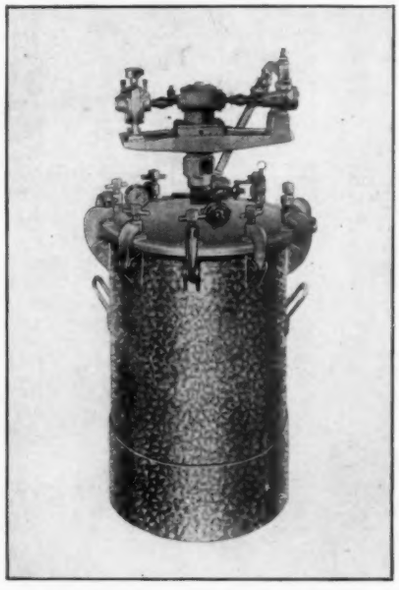
Worthington V-Belt Sheaves Are Quickly Detachable

Worthington Pump & Machinery Corp., Harrison, N. J., has added the Type Q-D quick detachable and quick demountable type of V-belt drive sheave to its line of "Multi-V-Drive" power transmission equipment. It is claimed that this feature achieves simplicity of construction and is suitable for any application where quick mounting of sheave to shaft is desirable.

Each sheave unit consists of two parts—a longitudinally split or clamp hub and a V-grooved rim. The hub is clamped to the shaft by a cap screw in its flange and is securely fastened by a standard keyway. A fit equal to a press fit is said to be provided. The rim is taper-fitted to the hub and is fastened with three draw bolts.

Small Painting Systems Developed by DeVilbiss

Type QBM small paint circulating systems developed by DeVilbiss Co., Toledo, Ohio, are claimed to make possible to the small manufacturer all the economies, safety and conveniences inherent in larger circulating systems for paint delivery. This system will supply a maximum of six production type spray guns in continuous operation, handling such materials as lacquers,



STEELWELD *Bending Presses*

45 STEELWELD PRESSES NOW SERVING THE AIRCRAFT INDUSTRY

Multiple-punching 150 holes ranging from .078 to .250 in size.

Punches are set to accurate scale readings as close as ¾" centers, and are individually gagged with built-in strippers. Steelwelds can be set up quickly for forming, multiple-punching, etc.

Steelwelds are playing an important role in the manufacture of airplanes for many leading concerns.

They are being used for wing, fuselage and other sections. Forming is done either with standard dies or rubber forms. Corrugating and multiple-punching is easily performed.

Steelwelds are simple to operate. They produce accurate parts in fast time on a continuous production basis. Dies are easily and quickly changed. A large range of standard size machines available.

Steelweld representatives in all principal cities.

JUST OFF THE PRESS
30-page catalog. Complete construction and engineering details. Mail request for free copy on your company letterhead.

THE CLEVELAND CRANE & ENGINEERING CO.
STEELWELD MACHINERY DIVISION
WICKLIFFE, OHIO.

CYRIL BATH & CO., GENERAL SALES AGENTS . . . . E. 70TH & MACHINERY AVE., CLEVELAND, OHIO

Other products: CLEVELAND CRANES and CLEVELAND TRAMRAIL

LET GraybaR TAG YOU A TRI/CLAD!

THE NEW GENERAL ELECTRIC POLYPHASE INDUCTION MOTOR

Whenever a basic advance in electrical products is made, you can count on GRAYBAR to be among the first to "tag" the benefits for wise buyers. Such is the case with General Electric's completely new "Tri-Clad" motor . . . designed to give extra protection three ways, along with higher operating efficiency and sleek, modern styling.

General Electric Motors and Motor Controls are typical of the "front-rank" lines of electrical equipment and supplies offered by GRAYBAR throughout its nationwide distribution network in 86 cities. Yet, in each community, the local GRAYBAR office is pledged to personal service, with individual attention to the needs of near-by buyers.

Thus, there's a double reason for going to GRAYBAR for "everything electrical": (1) The newest and best products, (2) from a "one-call" local source whose primary responsibility is keeping your good-will. Whatever your electrical needs, why not put them up to your local GRAYBAR Representative? Or, write direct for information or assistance.

HERE'S WHAT YOU GET in the new G-E TRI-CLAD

1 EXTRA PROTECTION
against physical damage
The sturdy, cast-iron frame, and end-shields with no openings above the center line, protect the vital parts against physical damage. There's no chance for falling materials or dripping liquids to get inside.

2 EXTRA PROTECTION
against electrical breakdown
The new stator windings of FORMEX* wire, together with improved insulating materials and methods, give extra protection against electrical breakdown.

3 EXTRA PROTECTION
against operating wear and tear
Fundamental improvements in bearing design give extra protection against failure or excessive wear in service. A scientifically improved lubricating system and double-end ventilation augment this protection.

1, 1½, 2, 3 hp. sizes now available, others soon ready.

*FORMEX—Reg. U.S. Pat. Off.

Executive Offices:
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GraybaR
IN OVER 80 PRINCIPAL CITIES

GraybaR QUALITY SINCE 1869 Distributed by GraybaR ELECTRIC COMPANY

synthetic enamels, paints, varnishes and shellacs.

Heart of the system is the tank assembly. Container is the standard Type QM unit, with agitator of 30 or 60 gal. capacity. Combination motor, speed reducer and pump is mounted compactly on a small platform of the tank lid. Either air or electric motor is available. Pump has no packing gland but incorporates a mechanical seal for greater wear resistance.

Three types are available. System *A* forces material under air pressure through a loop no longer than 200 ft. System *B* provides a loop as long as 450 ft., with individual fluid regulator for each gun. With system *C* the fluid is recirculated through the head of each gun, a practice recommended for materials which are difficult to keep in suspension. With it loop lengths up to 200 ft. are possible.

Capewell Hacksaw Blades Available in Five Types

Five types of metal cutting saw blades have been made available by Capewell Mfg. Co., Hartford, Conn. "Technite" blades, made of molybdenum high-speed steel, are recommended for high-speed, stainless and other hard-to-cut alloy steels. "Tunghard" blades are all-hard tungsten alloy blades for general service where fast speeds are not essential. "Tungflex" blades have hardened and tempered teeth of tungsten alloy steel. Back is flexible for cutting in difficult positions. "FleXloy" molybdenum steel blades are intended for general purposes. They are claimed to be unbreakable in a hacksaw frame. "High Speed" blades are made of tungsten high-speed steel.

"Tulca" Goggle Lens Is Claimed to Be Unbreakable

Univis Lens Co., Dayton, Ohio, has developed the "Tulca" goggle lens to provide increased safety for all industrial uses. Of dimensions equal to those of standard glass lenses, these lenses weigh only half as much and are said to stand up better under shock, abrasion and thermal stress.

Electrical Plane Fittings Made by American Phenolic

American Phenolic Corp., 1250 Van Buren St., Chicago, Ill. has developed two types of "Amphenol" electrical fittings especially for aircraft use.

Series AN electrical connectors have aluminum shells, with elements of high dielectric strength Bakelite. Wiring may be done without removing elements from shells. They are available in four types and eighteen different sizes.

The line of aluminum alloy conduit fittings comprises twelve classes and 130 pieces and is made for standard rigid or flexible aluminum conduit from 3/16 to 2½ in. Formed aluminum ferrules are fastened to the flexible aluminum conduit by roller crimping.

NEW MATERIALS

Free Machining Alloy Combines Four Features

"KR Monel" high-nickel alloy, announced by International Nickel Co., 67 Wall St., New York, N. Y., is said to have high strength, high corrosion resistance, to be capable of fabrication in automatic screw machines, and capable of heat-treatment after fabrication to provide an extra measure of strength and hardness. The alloy is available in rod and wire forms only.

Like the previously available "K Monel," "KR Monel" is not magnetic, thus making it suitable for service in airplane and other industries where resistance to magnetic influences is important. It is said to derive its free machining qualities from special heat-treatment at the mill before shipment. Yield strength as high as 130,000 lb. per sq.in. and tensile strength as high as 170,000 lb. per sq.in. are claimed.

TRADE PUBLICATIONS

Boiler Feed Systems Fred H. Schaub Engineering Co., Chicago, is circulating Catalog No. 640 which gives complete information on a line of boiler feed and condensate recovery systems, a line of liquid level controls.

Clutches The Conway Clutch Co., Cincinnati, has published bulletin No. L-29 which completely describes disc clutches. The necessary mounting dimensions, horsepower, torque data of stud drive disc clutches are also discussed.

Compressors Chicago Pneumatic Tool Co., New York, N. Y., is circulating bulletin No. 726, which describes and illustrates the operating features of horizontal-duplex motor-driven compressors.

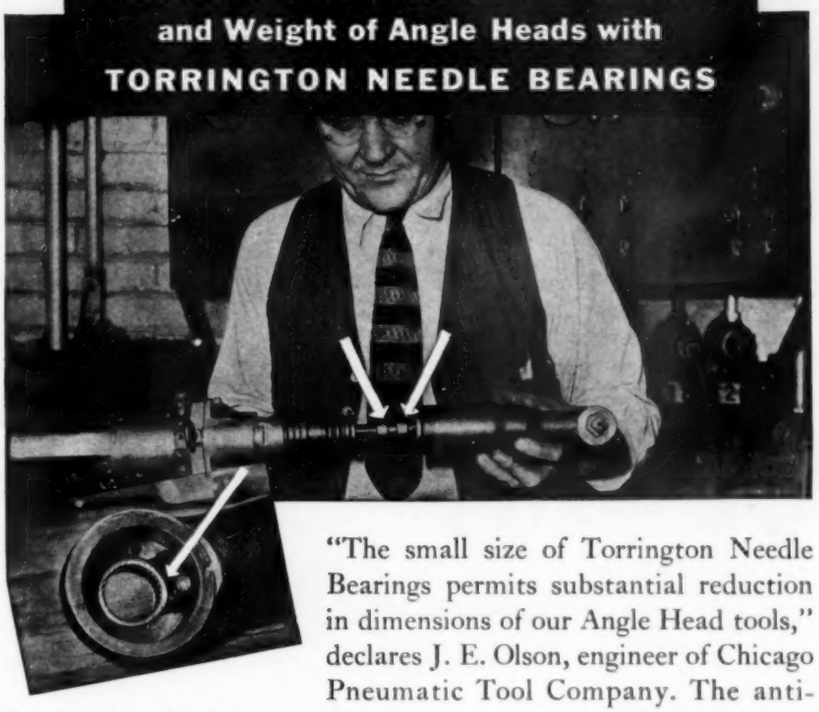
Controllers The Foxboro Co., Foxboro, Mass., has published bulletins which describe automatic temperature controllers, air or electric-operated.

Furnaces Catalog and Data Book No. 602, published by American Gas Furnace Co., Elizabeth, N. J., describes the operation, construction, and provides specifications of all standardized burners, furnaces and heating machines.

Heat-Treating Equipment Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has published a 4-page illustrated folder whicn describes Endo-Gas balanced-atmosphere heat-treating equipment.

Hydraulic Presses A 28-page bulletin has been published by Baldwin-Southwark Div. of the Baldwin Locomotive

CHICAGO PNEUMATIC CUTS SIZE and Weight of Angle Heads with TORRINGTON NEEDLE BEARINGS



"The small size of Torrington Needle Bearings permits substantial reduction in dimensions of our Angle Head tools," declares J. E. Olson, engineer of Chicago Pneumatic Tool Company. The anti-friction Needle Bearings (shown above on an Angle Head drive shaft) occupy no more space than a plain bushing—yet carry heavy loads at high speeds with great efficiency and long life, for radial capacity is extremely high in proportion to size.

"And they require no extra lubrication systems," add Chicago Pneumatic's engineers, "because large supplies of grease are retained within the close-fitting lips of the race"—a special advantage for bearings in hard-to-reach spots.

Torrington Needle Bearings are quickly installed at low cost because they are self-contained units. Another advantage: initial costs are surprisingly small.

Are you seeking ways to improve your product's efficiency while keeping costs and space requirements low? The extraordinarily compact, high-capacity Torrington Needle Bearing may be the answer to your problem. Our Engineering Department will gladly help you plan the inclusion of its advantages in your product. For more detailed information, write for Catalog No. 105. For Needle Bearings to be used in heavier service, ask our associate, Bantam Bearings Corporation, South Bend, Indiana, for a copy of Booklet 103X.

THE TORRINGTON COMPANY, TORRINGTON, CONN., U. S. A. • ESTABLISHED 1866

Makers of Needle and Ball Bearings

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TORRINGTON NEEDLE BEARING

KEEP YOUR WELDING COSTS DOWN WITH MUREX

GENEX

The SPEEDY, EASY-TO-USE ALL-PURPOSE ELECTRODE FOR STRAIGHT POLARITY OR A. C. WELDING.

Designed for welding in any position... flat, vertical, or overhead...and to readily bridge gaps where assembly fit-up is imperfect, Murex Genex Electrodes have several outstanding features which make them highly economical in operation. They are used at higher currents, which steps up welding speed. They burn with less spatter; less smoke, and so provide better visibility of the arc and the molten pool of weld metal. The slag is easy to remove and does not cling to the edges of the weld, even on heavy fillets.

Send for complete information, or ask to have a representative call and show you what these electrodes can do.

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Investigate Thermit Welding, too—in use since 1902 for heavy repair work, crankshafts, etc.

Works, Philadelphia, which describes the operation and construction of hydraulic presses.

Insulated Wire John A. Roebling's Sons Co., Trenton, N. J., has issued a 34-page booklet, "Rubber Covered Wires and Cables," which provides the latest information on building wires and cables.

Machine Parts Building Fiber Co., Inc., Tonawanda, N. Y., is distributing a 36-page booklet which presents engineering reference data and suggests uses for its products.

Motors General Electric Co., Schenectady, N. Y., is circulating Bulletin No. GEA-3307 which describes the construction and application of self-starting synchronous inductor motors.

Pipe Fittings Taylor Forge & Pipe Works, Chicago, has published a 216-page catalog which provides technical data on the company's line of seamless steel pipe fittings for welding and forged steel flanges.

Pumps Allis-Chalmers Mfg. Co., Milwaukee, Wis., has issued Bulletin No. B-6140 which describes the operation and construction of "Electrifugal" pumps for 1 to 10 hp. inclusive.

Relays A 4-page folder No. GEA-1755C, circulated by General Electric Co., Schenectady, N. Y., describes the application and operating features of general-purpose photoelectric relays.

Steel Machining Carboloy Co., Inc., Detroit, is circulating a 16-page engineering bulletin, No. GT-123, which covers tool design and selection, chip breaker design and grinding, machine maintenance design, and depth of cut and grade selection for different types of steels.

Steel Plates Lukens Steel Co., Coatesville, Pa., has published an 8-page bulletin which provides technical data for the engineer and buyer of the steel plates.

Threads FabriSteel Products, Inc., Detroit, Mich., has published a new bulletin in which is described a new method of increasing thread area in sheet metal and discusses how assembly is simplified. It includes a table of specifications of all the sizes.

Time Switches Bulletin No. GEA-2963B, circulated by General Electric Co., Schenectady, N. Y., describes and illustrates the operating features of time switches.

Transformers A 16-page illustrated bulletin describing the completely self-protecting power transformers is circulated by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The transformers are specially designed for unit substation service on municipal, or industrial distribution systems.

Tubing Summerill Tubing Co., Bridgeport, Pa., has published an 8-page bulletin which describes the operation and the uses to which steel seamless tubing has been put.

Valves Hauck Mfg. Co., Brooklyn, N. Y., has published a 2-page folder containing information regarding the applications and dimensions of oil valves.

Voltmeters General Electric Co., Schenectady, N. Y., is circulating a 4-page folder which describes the applications and performance of electrostatic voltmeters.

NEW BOOKS

MATERIALS HANDBOOK, FOURTH EDITION—*By George S. Brady.* 591 *pages. Published by the McGraw-Hill Book Company,* 330 *West* 42 *St., New York.* $5.00.

One would not expect to look for romance in a volume subtitled "An Encyclopedia for Executives," but here are to be found strange materials from strange lands sandwiched in between their more commonplace neighbors. This juxtaposition is not so hard to understand when one stops to think that much of man's wandering about the globe has been in search of new and useful materials. Definitely this is a book to browse through as well as refer to.

By doing so the reader may learn that in 1903 Auer Von Welsbach obtained a patent for pyrothoric alloys now used most as a sparking metal in cigarette lighters. He may learn also that Kittool, valued as a fiber for machine brushes, comes from the leaves of a special type of palm tree, native to Ceylon and India. Mullite, he will discover, was found originally on the Isle of Mull and forms a refractory for furnace linings. Page after page discloses little known facts, some of them useful but all of them interesting.

Originally compiled in 1928 from data gathered by the author when acting as American Trade Commissioner to three foreign countries, the Materials Handbook is necessarily subject to repeated revisions in order to keep step with the times.

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MODERN PLASTICS CATALOG, 1941—176 *pages. Published by Breskin Publishing Corp.,* 122 *East* 42*nd St., New York.* $3.50.

This catalog, formerly issued as an annual number of *Modern Plastics,* is now published independently. It is bound in imitation leather, with index markers of the same material. Each one of its nine sections treats of some phase of plastics, such as engineering, molding and fabricating, machinery and equipment, and plastic coating. Advertising pages are combined with editorial presentation in each section.

WELDING METALLURGY—*By O. H. Henry, associate professor of metallurgical engineering, and G. E. Claussen, research assistant, Polytechnic Institute of Brooklyn. 369 pages. Published by the American Welding Society, 33 West 39 Street, New York.* $1.50.

One of the more useful functions of technical societies within the past few years has been the sponsorship of educational lectures for the benefit of members and guests. This book includes two such series.

Volume 1 consists of ten lectures presented by the American Welding Society during the 1939-40 season. Volume 2 includes a similar series to be concluded this year. All lectures pertain directly to the way in which metal acts during welding and the practical considerations that arise. Such topics as crystalline structure, rates of cooling, welding difficulties, fluxes and slags, seasoning and stress relief are considered in turn.

•

SABOTAGE: HOW TO GUARD AGAINST IT—*By Harry Desmond Farren. 56 pages. Published by the National Foremen's Institute, East River, Conn.* $1.00.

Although the factual aid in sabotage prevention is obscured somewhat by a scarehead introduction, this little volume is timely and contains some practical pointers. It reviews dramatically a number of examples of suspected and proved sabotage, going back to the last World War for its more sensational case histories. However, it winds up by telling employers and employees the things they should do to prevent disruption of industry from this source.

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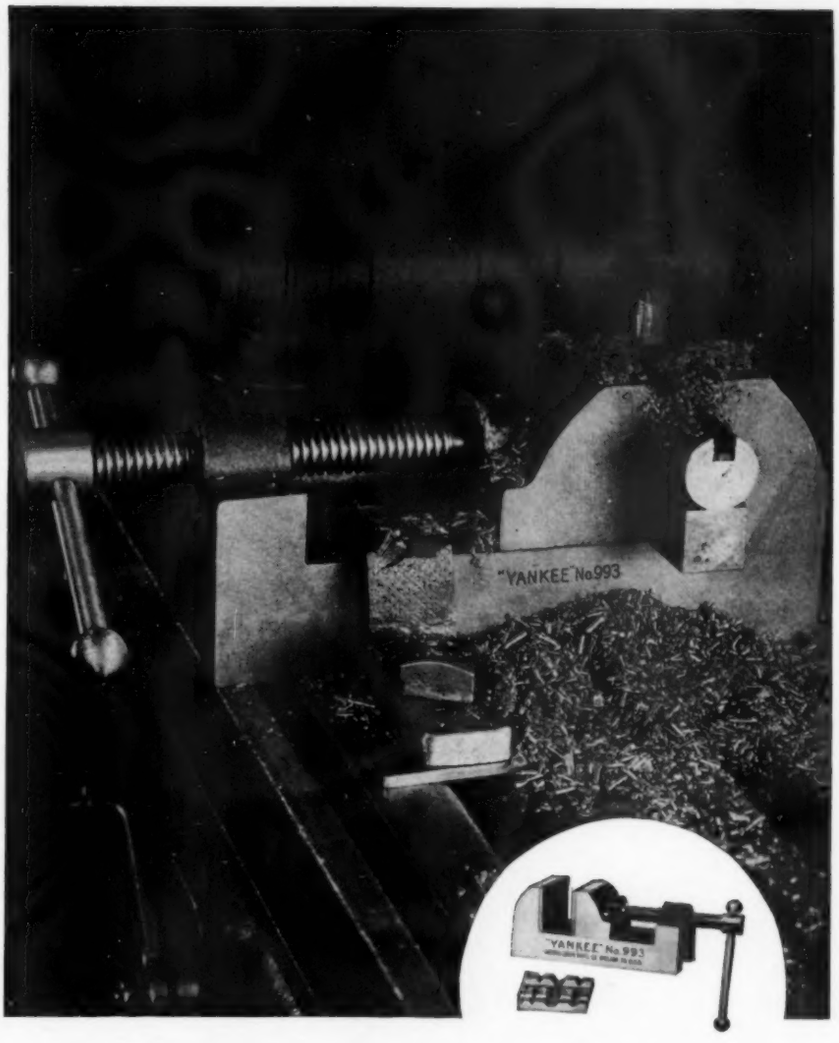
STEEL CASTINGS HANDBOOK—*First edition. Published by Steel Founders' Society of America, 920 Midland Bldg., Cleveland, Ohio.* $2.00.

Eminently suited both for use as a reference volume by engineers and designers, and as a text book for engineering students, this new and comprehensive handbook covers all phases of the steel casting industry and its products. It contains much material never heretofore published. More than two years were spent in gathering the data which were reviewed by more than 70 experts serving on various editing committeess.

Profusely illustrated with photographs, line drawings and curves, this 510-page handbook should be of particular interest to every engineer and plant manager having much to do with the specification of materials. The 17 chapters give a brief history of the steel casting industry, discuss methods of producing various types of castings, and devote much space to the physical and mechanical properties of various steel casting alloys. A large number of tables and curves are included in the handbook to provide factual information of considerable value.



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"Yankee" Vise also available with removable swivel base. Sizes, Nos. 1991, 1992, 1993 and 1994.

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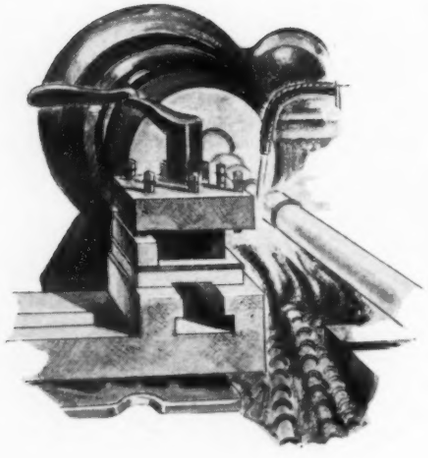

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